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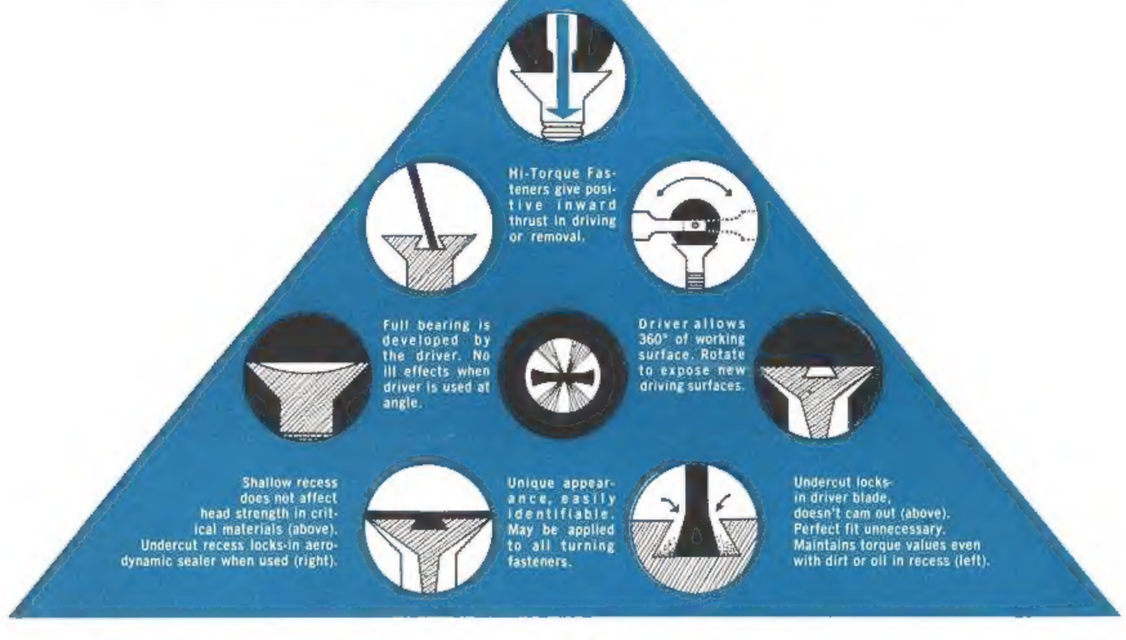

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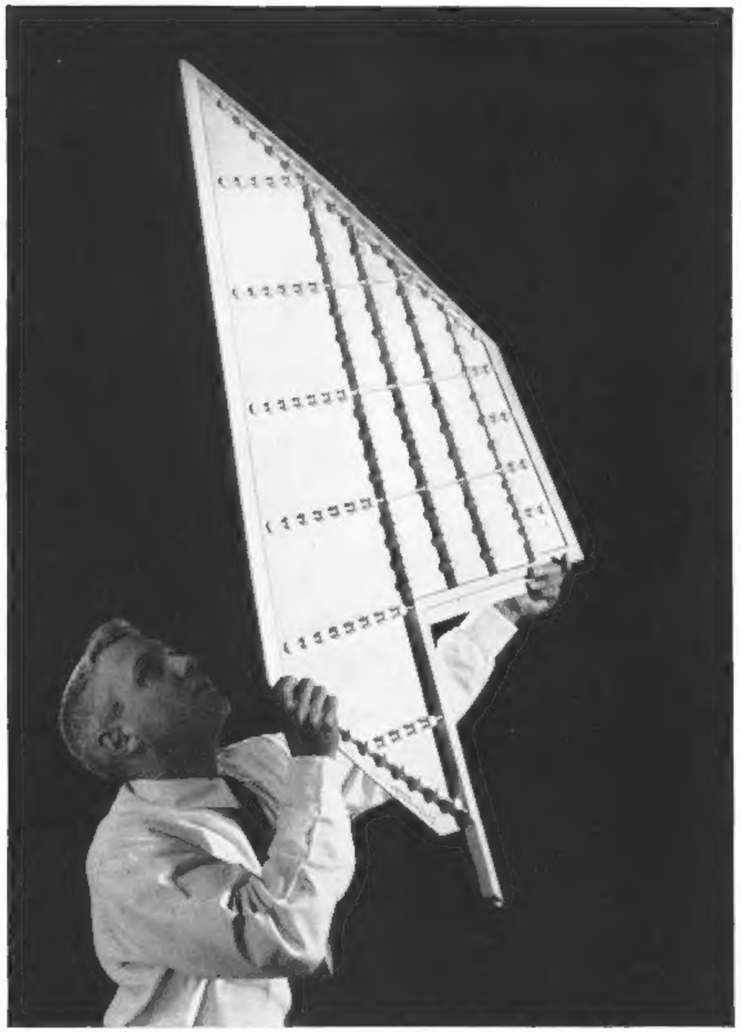

THIN-WALL magnesium casting for the Regulus missile fin produced by Dow.

AVIATION CALENDAR

Oct. 21-22—Canadian Aeronautical Institute—Institute of the Aeronautical Sciences Meeting, Montreal, Canada.

Oct. 21-23—Conference on New Developments in the Field of Power, American Society of Mechanical Engineers, Americus Hotel, Allentown, Pa.

Oct. 21-25—45th National Safety Congress, Conrad Hilton Hotel, Chicago.

Oct. 22—Third World Conference for Aviation, month-long meeting on tariffs, cargo, etc., Sao Paulo, Brazil.

Oct. 24-25—Fourteenth Annual Display, Aircraft Electrical Equipment, Aircraft Electrical Society, Pan Pacific Auditorium, Los Angeles.

Oct. 24-25—Computer Applications Symposium, Morrison Hotel, Chicago, sponsored by Armour Research Foundation of Illinois Institute of Technology.

Oct. 28—Sixth Aviation Conference, Worcester Municipal Airport, Mass.

Oct. 28-29—Third Annual Meeting, Association of the U. S. Army, Sheraton-Park Hotel, Washington, D. C.

Oct. 28-29—First National Conference on Applied Meteorology, Hotel Statler, Hartford, Conn.

Oct. 28-30—Annual East Coast Conference on Aeronautical and Navigational Electronics, Fifth Regiment Armory, Baltimore, Md.

Oct. 28-31—Second Winter Meeting, American Nuclear Society, Henry Hudson Hotel, New York.

Oct. 28-31—National Industrial Packaging & Handling Exposition, Atlantic City Convention Hall, N. J.

Oct. 30-Nov. 1—Annual Meeting, Air Traffic Control Assn., CAA Technical Development Center, Indianapolis, Ind.

Oct. 30—Aviation Electrical Equipment Display, U. S. Grant Hotel, San Diego.

Oct. 31-Nov. 1—Fourth Annual Meeting, Professional Group on Nuclear Science, Henry Hudson Hotel, New York.

Nov. 1-3—Dallas Air Fair, sponsored by the

(Continued on page 6)

AVIATION WEEK • OCTOBER 21, 1957

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AVIATION CALENDAR

(Continued from page 4)

Dallas Junior Chamber of Commerce, Addison Airport, Dallas, Tex.

Nov. 2-8—Second World Metallurgical Congress & 39th National Metal Exposition & Congress, Palmer House, Hotel Sherman and International Amphitheatre, Chicago.

Nov. 4-8—Fourth Institute on Electronics in Management (automatic data processing system), The American University, 1901 F St., Washington 6, D. C.

Nov. 5-7—Joint Military-Industry Guided Missile, Reliability Symposium (limited to those with Secret security clearance), Naval Air Missile Test Center, Pt. Mugu, Calif.

Nov. 6-8—Third Annual Symposium on Aeronautical Communications, Hotel Utica, Utica, N. Y.

Nov. 7-8—National Meeting, Weapon System Management, Institute of the Aeronautical Sciences, Statler-Hilton Hotel, Dallas, Tex.

Nov. 11—Plastics for Airborne Electronics, Regional Technical Conference, Society of Plastics Engineers, Hotel Ambassador, Los Angeles.

Nov. 11-13—Third IRE Instrumentation Conference and Exhibit (Data Handling), Atlanta-Biltmore Hotel, Atlanta, Ga.

Nov. 11-15—1957 International Air Safety Seminar, Flight Safety Foundation, Palo Alto, Calif. FSF-Aviation Week Safety Awards Dinner, Nov. 14. For Details write FSF, 468 Fourth Ave., N. Y. C.

Nov. 12-13—Seventh Aircraft Hydraulics Conference, Park Shelton Hotel, Detroit, sponsored by Vickers Inc. (invitation only).

Nov. 13-14—Mid-America Electronics Convention, Municipal Auditorium, Kansas City, Mo.

Nov. 13-15—18th Annual Convention, National Aviation Trades Assn., Hotel Adolphus, Dallas.

Nov. 17-21—Eighth National Plastics Exposition, International Amphitheatre, Chicago.

Nov. 18-22—Third Norelco Electron Microscope School, Instruments Division, Phillips Electronics, Inc., 750 S. Fulton Ave., Mt. Vernon, N. Y.

Nov. 18-29—Technical Conference, International Air Transport Assn., Miami, Fla.

Nov. 20-22—30th Meeting, Aviation Distributors and Manufacturers Assn., Sheraton-Cadillac Hotel, Detroit.

Dec. 4-5—Symposium on high temperature strain gages, Aeronautical Structures Laboratory, Naval Air Materiel Center, Philadelphia 12, Pa.

Dec. 9-13—1957 Eastern Joint Computer Conference and Exhibit, Sheraton Park Hotel, Washington, D. C.

Dec. 18—Gas Turbine Development, speaker: Rear Adm. S. B. Spangler, USN, Air Development & Materiel Center, at Engineers Club, Philadelphia, Pa.

Jan. 6-8—Fourth National Symposium, Electronics Reliability and Quality Control, Hotel Statler, Washington, D. C.

Jan. 29-31—Fourth Annual Meeting, American Astronautical Society, N. Y. C.

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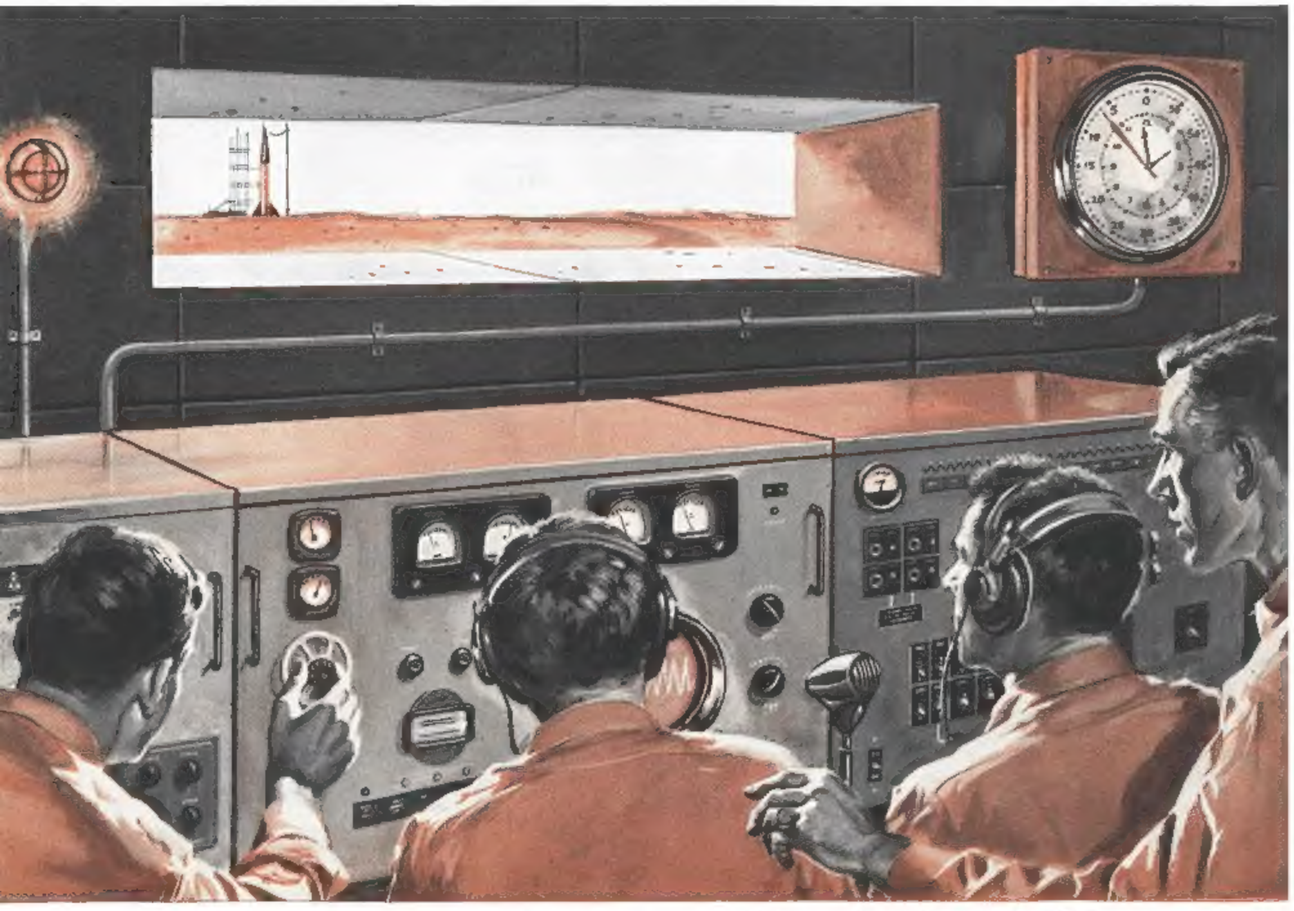

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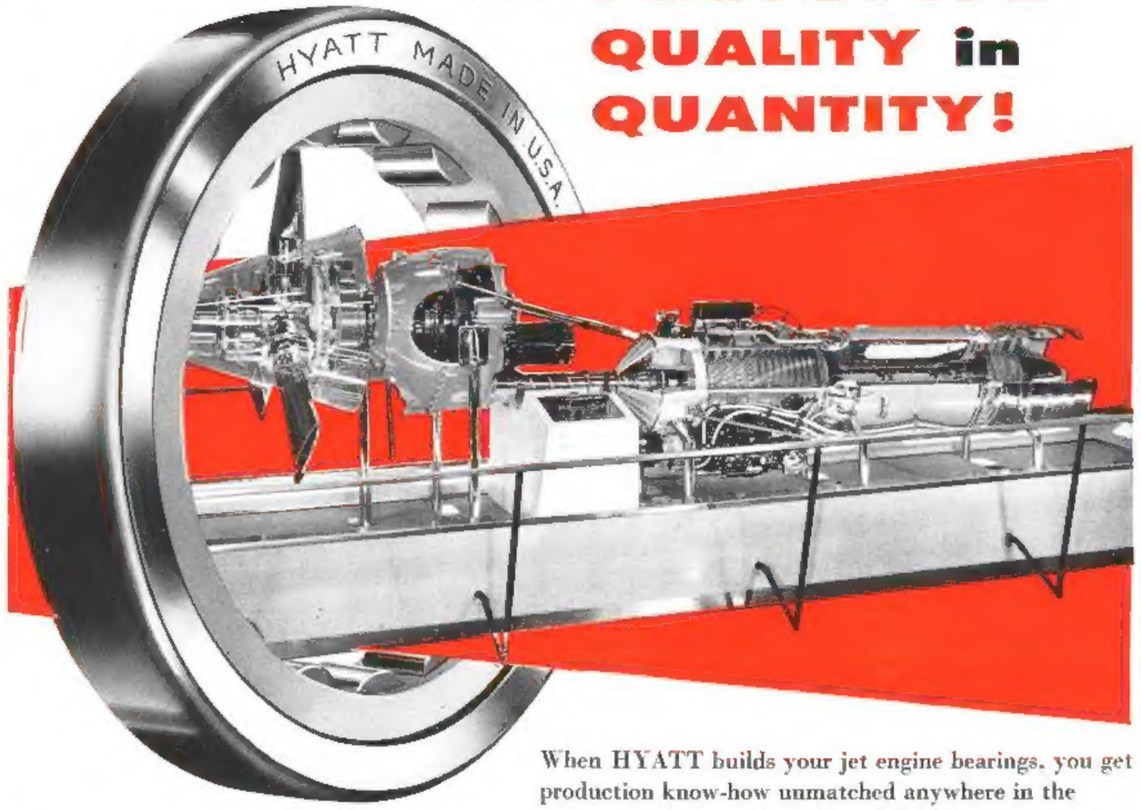

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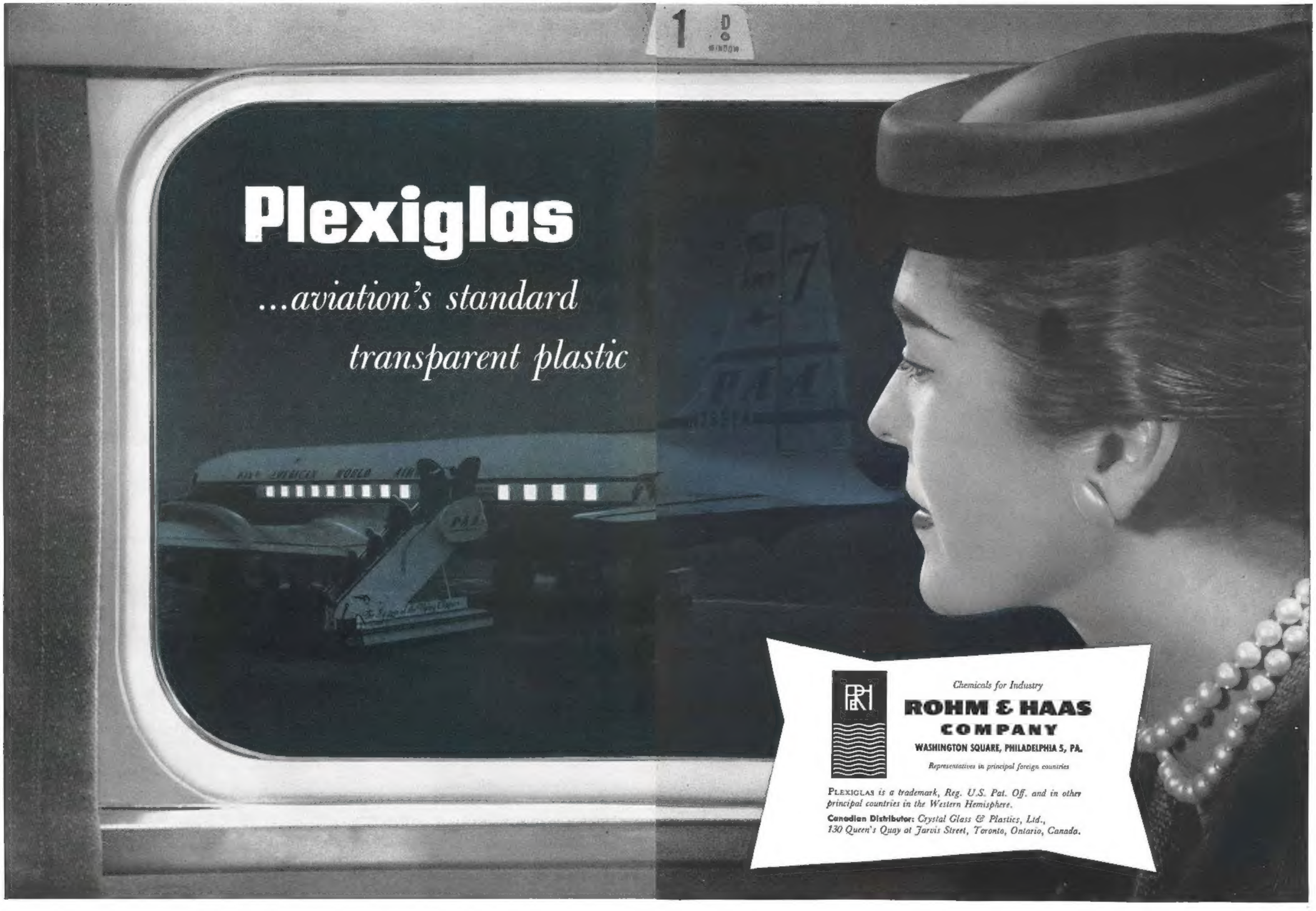
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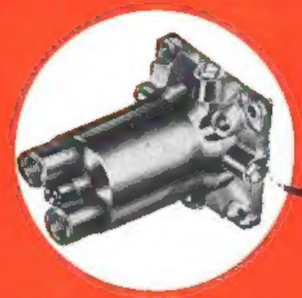
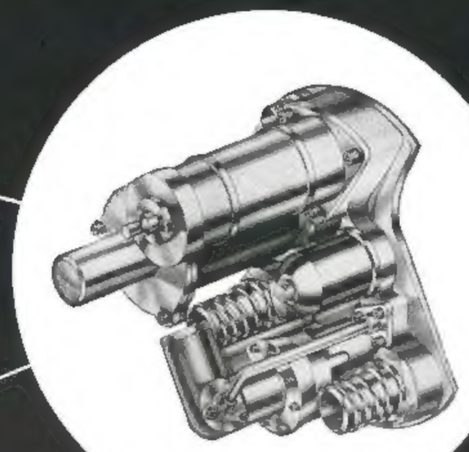


HYDRAULIC MOTORS



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October 21, 1957

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▶Powerful, long-range radar units based in Turkey have tracked Russian launchings for two years.

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▶Miami delegates feel boost in first-class fares may help to offset mounting costs of airlines.

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▶Design features include intakes, blunt trailing edges, conical camber.

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EDITORIAL

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COVER: Avro CF-105 Arrow, shown at rollout in Malton, Ontario, has thin wing with conical cambered leading edges and blunt trailing edges, area-ruled fuselage. Note aerodynamic fence, used to improve tip conditions by alleviating strong spanwise flow across Arrow's delta wing. Wide notch has been cut in wing leading edge just inboard of leading edge extension. Notch ends in low, wide ramp which extends back over wing. Ramp is raised above wing, well back on chord. Air which passes into notch and up on ramp moves straight back over wing combining with spanwise flow to give flow over outboard wing section a new direction.

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70,037 copies of this issue printed

AVIATION WEEK • October 21, 1957 • Vol. 67, No. 16

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EDITORIAL

Why, Mr. President?

On page 26 of this issue we are publishing the first accurate and detailed account of how the U.S. has been tapping Russian missile test secrets for more than two years. Many people will ask why we are publishing a story that on the surface looks as though it might be a grave breach of genuine military security. There are two basic reasons for publishing this story:

• **First, it is not really a secret** from anybody except the vast bulk of the American people who are most vitally affected by it. The Russians have known about it for some time and there is little they can do beyond what they are already doing—threaten Turkey where this radar equipment is located. We have known about it for more than a year. News of this operation can be obtained in Athens' cafes, Pentagon corridors, Los Angeles cocktail parties and avionic professional society gatherings. Bits and pieces of the story already have appeared in the public prints of several nations.

We have discussed this situation with people deeply concerned with the U.S. missile program and its progress relative to the Soviet effort and have been unable to unearth a single valid reason why the full story should not be told now. We expect the usual cry of "wolf" from the type of military and political security officer who still withholds from public release information that is officially removed from all military security classification and who quivers every time the American press reports the roll-out of a new bomber within full public view or the firings of missiles from Cape Canaveral where housewives, photographers and curious tourists can watch the proceedings from public beaches.

• **Second, the story of how this fairly detailed** and accurate data on Soviet missile progress has been available to the top level U.S. officials for more than two years is one of the most significant facts of the current crisis this country faces in its international and internal affairs. It proves conclusively that the officials of the executive branch of the government knew positively of the basic facts in the onrush of Soviet science in developing ballistic missiles and the hardware associated with the Sputnik satellite. They not only failed to warn the American people of the potential danger in these developments but, at the same time, they deliberately and unmistakably took action that is seriously weakening both our airpower in being and the quantity and quality of our future aerial weapons.

Existence of this excellent source of data on the Soviet missile test program, plus other non-scientific intelligence techniques explains why President Eisenhower and his top defense officials, such as Defense Secretary Charles E. Wilson and Deputy Defense Secretary Donald A. Quarles, could shrug their shoulders and blandly announce to the public: "This is no surprise; we knew about it all the time." This is true.

But in the same breath they also added that these developments such as the testing of both IRBM and ICBM and the orbiting of the Sputnik were "no cause for alarm." This is patently false as evidenced by the private alarm that is now shuddering through the White House and Defense Department and the bitter reaction rolling in from the NATO countries abroad who feel that the U.S. has committed an unforgivable error in allowing the Soviets to forge ahead in the scientific fields that are the foundation of new weapons development.

In addition to the evidence available on Russian missile firings, a delegation of top USAF officers led by the then Chief of Staff Gen. Nathan F. Twining and including such expert appraisers of aircraft as Lt. Gen. C. S. "Bill" Irvine, Gen. Thomas S. Power, now commander of Strategic Air Command and Maj. Gen. Albert Boyd, who has test flown every new USAF and NATO aircraft for a decade, visited the Soviet Union in the summer of 1956 and got the best first hand look at Russian aerial hardware ever afforded western visitors. Their grave warnings to the White House on the pace of the Soviet advance were rudely brushed aside and obviously have played no significant role in U.S. military and international policy planning.

Now what have our leaders of the executive branch of the government been doing while they were getting all this data on the march of Soviet scientific weapons progress? They have been and still are embarked on a fiscal policy that is shaking the military, scientific and industrial foundations of our national defense system so badly that only emergency action with the utmost speed will prevent a major deterioration of our atomic airpower strength in relation to the Soviets in the immediate future.

The alienation of science from the defense effort has been going on for some years and already had been detailed in these columns. But the recent public outbursts of Dr. Clifford C. Furnas and Trevor Gardner are symptomatic of this problem. Both are Republicans; both held top scientific appointive posts in the Defense Department and both found it impossible to work effectively in the atmosphere that regarded scientists as "just another pressure group" or "eggheads." President Eisenhower's own public statement that the U.S. satellite Vanguard project was "sold" to him as a scientific project to be separate from the military program is the most convincing evidence of all of this basic cleavage between our current political leaders and the scientific community that is the foundation of military weapons development in modern times.

The other action that is already beginning to tear down both our existing military airpower strength and the industrial complex that is developing and producing future weapons is the fiscal policy of imposing an arbitrary $38 billion expenditure ceiling on the Defense Department for Fiscal 1958.

This fiscal policy is keeping our ballistic missile development and test program on a five day week, has already made minor cuts in the funding of this "business as usual" program and is now forcing an across the board cut of about 25% in military aircraft and missile production rates. This means that we will get fewer new weapons much later than originally planned under the Administration-approved program of two years ago. It also means that we will be further behind in our technological race with the Soviets and our international prestige as leader of the free world will decline even further.

It is high time the American people asked President Eisenhower why, in view of the overwhelming evidence available to him during the past two years on Soviet technical progress, he is still pursuing a policy that is slowing the pace of our military technology and sapping our future military strength.

—Robert Hotz

WHO'S WHERE

In the Front Office

Gen. Ira C. Eaker, USAF ret. director of Douglas Aircraft Co.'s eastern offices, representing the president and supervising Douglas operations in Washington, New York and Dayton. Gen. Eaker retired as vice president of Hughes Tool Co. earlier this month.

Max Golden, promoted to Deputy Assistant Secretary of the Air Force, Materiel, from former post as Deputy for Procurement and Production.

David D. Coffin and **Dr. Thomas H. Johnson,** vice presidents, Raytheon Manufacturing Co., Waltham, Mass. Mr. Coffin is manager Missile Systems Division and Dr. Johnson is manager Research Division.

Dr. John D. Kleis, vice president and director of research, Fansteel Metallurgical Corp., North Chicago, Ill. Dr. Kleis succeeds Dr. Leonard F. Yntema, retiring.

John B. Gates, vice president-finance, Pan American World Airways, Inc.

Robert G. Clark, vice president and treasurer, Epsco, Inc., Boston, Mass.

William O. Boschen, vice president of Avien, Inc., Woodside, N. Y., has also been named the general manager. Also: **Seymour Rabinowitz,** engineering manager.

John Bender, vice president of Humphrey, Inc., San Diego, Calif., has also assumed the post of sales manager.

Sherwood A. Nichols, a vice president and director of Transocean Air Lines, has been appointed general manager of Iranian Airways.

Lt. Col. John H. Savage, USA, has been appointed Chief of the Ballistic Missile Office, U. S. Army Ordnance District, Los Angeles, Calif.

Rear Adm. Walter F. Rodee, now Naval Forces Commander, North American Air Defense Command Headquarters, Colorado Springs, Colo.

Honors and Elections

The National Advisory Committee for Aeronautics' Exceptional Service Medal, the NACA's second highest honor, has been presented to **John B. Parkinson** and **Anshal I. Neihouse,** research scientists of the Langley Aeronautical Laboratory. Mr. Parkinson, chief of the Hydrodynamics Research Division, and Mr. Neihouse, head of the Spin Tunnel, were cited for "research that has contributed significantly to the advancement of aviation in the United States."

A. M. Rochlen, vice president-public relations of Douglas Aircraft Company, has received the Cross of the French Legion of Honor "for outstanding achievement in furthering cooperation between the French and American aircraft industries and his contributions to advancement and public acceptance of international air transport."

Changes

Joseph W. Lewis, assistant to the president, Beckman Instruments, Inc., Fullerton, Calif.

Samuel F. Leib, manager-interline air freight sales, American Airlines, Inc.

INDUSTRY OBSERVER

► Third firing of the Atlas intercontinental ballistic missile from USAF Missile Test Center, Patrick AFB, Fla., is scheduled to come off late this month or early November. As in first two launches, firing will not be a distance trial. Missile will not carry all its operational components, and primary purpose of the test will be a checkout of the propulsion systems.

► **Boeing Bomarc air defense missile recently had an extremely successful firing mission at USAF Missile Test Center, Cape Canaveral, Fla. Bomarc was fired automatically with nearest control personnel more than 10 mi. from the launching pad, climbed to 60,000 ft. and intercepted and destroyed a target drone at a range of more than 100 miles from the Cape. Air Defense Command is programming 20 operational squadrons of Bomarcs.**

► Japanese air force is extremely interested in Grumman's F11F-1F Mach 2 interceptor for its air defense forces. Pressure is building up in Japanese papers to buy the aircraft, and Japanese delegation on recent visit to the U. S. insisted on a demonstration of the aircraft at Edwards AFB, Calif., although it was not on their original program.

► **Missile experts working on USAF intercontinental ballistic missile programs have calculated that the thrust required to put the Soviet's 184 lb. Sputnik satellite into its orbit would be sufficient to deliver a 4,000 lb. warhead over a 1,500 mile range if used for a ballistic missile.**

► Pratt & Whitney J52 turbojet engine will power the air-to-surface missile being developed for the Boeing B-52 by North American Aviation rather than two General Electric J85s which had been tentatively considered in early planning.

► **Marquardt Aircraft Co. has built and shipped an afterburner to Fairchild Engine Division for use with the latter's J83 turbojet engine. Power boost with afterburner will be about 50%. Northrop is still considering the J83 for its T-38 jet trainer, although General Electric's J85 apparently has the inside track. Both engines are in the 2,500-lb.-thrust category without afterburner.**

► Minimum horizontal velocity for precisely establishing a circular orbit for the Vanguard satellite is 25,034 fps. Launching vehicle design calls for a launching speed considerably in excess of this to allow for performance shortcomings in various components and stages.

► **Solar batteries powering the 6.4 in. test spheres for the Vanguard satellite would make tracking possible for years if sphere achieves an orbit.**

► Boeing is seriously studying proposals for a large vertical takeoff design incorporating 16 turboprop engines mounted in tandem at each end of eight nacelles—four nacelles per wing. For vertical lift, front tractor engines and propellers would tilt 90 degrees upward and rear pusher powerplants 90 degrees downward.

► **Large scale production of the Orenda Iroquois turbojet engine by Curtiss-Wright reportedly hinges on its acceptance for use in a new USAF bomber. Several U. S. fighter manufacturers with aircraft whose performance is limited by powerplants rather than airframe also are interested in the engine.**

► The Martin Co. is interested in a slightly redesigned version of the Iroquois for use in the SeaMaster jet seaplane. Engine would require enlarged compressor to give greater pressure rise for better transonic efficiency.

► **West German air force has placed a follow-on order for Lear ADF-14 transistorized automatic direction finders. Order brings value of ADF-14s ordered by Germans to $1.5 million.**

Washington Roundup

Middle East Crisis

Nikita Khrushchev's newest swagger induced by successful Soviet firings of an intercontinental ballistic missile and the Sputnik earth satellite is beginning to worry Washington observers on both sides of the diplomatic fence.

They fear the overly confident Communist party boss may overplay his hand in the Middle East—possibly even risking a move of Soviet "volunteers" against Turkey from Syria—on the assumption that ballistic blackmail will keep the U.S. at arm's length. Aside from the political considerations, one of the reasons Russia wants to isolate Turkey from the West is the existence of U.S. radar units there to track Soviet missile firings (see page 26). If Khrushchev decides to gamble, Soviets probably will blame the initial blow on the Turks, a tactic they used in Korea to try to justify their actions in neutralist nations.

Scientific Manpower

Russia's satellite has spurred a strong drive among congressional members to take action to increase this country's reservoir of technical and scientific personnel. Numerous bills providing various types of federal scholarship programs were introduced this session, but they weren't pushed.

Sen. Homer Capehart (R.-Ind.) said last week on his return from a tour of Russia, Poland, Czechoslovakia and East Germany: "In Russia, the scientists and technicians have been made the heroes of Communist society. They pick their brains out and utilize them. In the U.S., on the other hand, there is this tendency not to cooperate and, in some cases, to beat their brains out. What I want to tell is that this attitude of non-cooperation must change. We must pay more attention to scientists and to educating more scientists."

Grass Roots Complaints

Russia's Sputnik and the U.S. missile program won't be the only thing on the mind of Congress when it again starts to air complaints against the way economy is being enforced on the Defense Department. There are the cries coming from constituents in areas where military installations are being closed or drastically curtailed to save money. Three prime sore spots aggravated by USAF's Air Materiel Command are at the Memphis, Tenn., Air Force Depot; Shelby, Ohio, Air Force Depot, and Topeka, Kan., Air Force Depot. Cuts at these and other centers are creating local political hornet's nests.

Airport Hassle

Selection of a Baltimore consulting engineer firm by Special Presidential Aide Elwood Quesada to survey Washington's long drawn-out airport problem is likely to draw fire from backers of Virginia as a site for the badly-needed second airport. Charles Allen, a partner in the firm that will undertake the survey in a joint venture with the firm of Hayes, Seay, Mattern and Mattern of Roanoke, Va., has served as chairman of the State Aviation Commission of Maryland since April, 1955.

Maryland has made a vigorous fight for Baltimore's Friendship Airport as a second Washington airport and recently asked for Quesada's reassurance that Friendship would be included in the study by the engineers.

Allen also testified at the Civil Aeronautics Board Washington-Baltimore adequacy of service investigation to support Greater Baltimore Committee exhibits describing the Friendship facility from a technical standpoint. He said that J. E. Greiner, in association with other engineers, was "responsible for the architectural, engineering, planning development and supervision of construction" of the airport and added, "We think it is one of the best in the world."

McElroy Disappointed

Almost overlooked in the rush of news about Russia's earth satellite was evidence that Neil H. McElroy, new Secretary of Defense, was disappointed in his first meeting with his new boss at the White House. McElroy conferred with President Eisenhower only 24 hours after taking office and holding a congenial, if somewhat stiff, initial meeting with the Pentagon press corps. Photographers who were admitted to take pictures said afterward the two men appeared serious. Eisenhower was "grim." When McElroy left the White House, he displayed short patience with waiting reporters, shouldered them aside in a manner that brought charges of rudeness. One interpretation of the incident: McElroy, a man with a wide reputation for shrewd public relations in his regular job as president of Procter & Gamble, was seriously irritated during his session with the President.

General Motors Decline

General Motors Corp. has fallen to 16th place in the newest compilation of the 100 largest defense contractors. The listing covers the two years from January, 1955, to the end of 1956. In a 6½-year list, starting in July, 1950, General Motors still stands in second place. Winner on both lists: Boeing Airplane Co., which has been given more than $7 billion in business since 1950 and $1.9 billion in the last two years. Aircrafts dominate the top ten in the new list: General Dynamics, North American, United Aircraft, General Electric, Lockheed, American Telephone and Telegraph, Ford, Douglas and McDonnell.

Contract Principles

Seven-year effort of Defense Department to get a set of Contract Cost Principles has culminated in a 42-page document now being circulated for comment in industry circles. Aircraft Industries Assn. will launch its study at a committee meeting in about one month, is expected to come up with considerable criticism of the proposals. Pentagon has set a Dec. 16 deadline for comments.

Profit Decline

Results of second quarter operations by commercial airlines show a continued upward trend in revenues and a continued downward trend in net profits, according to a quarterly report issued by the Air Transport Assn. Domestic trunk airlines in the period April through June reported $367,947,000 in revenue, an increase of $40,388,000 over the same period in 1956. Net profits, however, dropped from $20,883,000 for the second quarter of 1956 to $16,076,000 for the second quarter of this year, a decrease of 23%. —Washington staff

ARTIST's sketch shows location of the major Russian ballistic missile test center at Krasnyy Yar located due west of a large bend in the Volga River between Stalingrad and Saratov. Intermediate range runs southeast with impact area in the Uzbek Desert near the Afghanistan border. Long range missiles and the Soviet's Sputnik satellite are fired on a track just a few degrees north of due east and impact in the sea just beyond Vladivostok. U. S. operated radar in Turkey can track along entire path of intermediate range missiles and can establish trajectory along long-range missile flight path

How U.S. Taps Soviet Missile Secrets

Powerful, long-range radar units based in Turkey have tracked Russian launchings for two years.

Washington—U S has been tapping Russian missile secrets for more than two years by means of extremely powerful long-range radar and other equipment based in Turkey. Operation of this equipment, well known to the Soviet Union, is considered by diplomatic sources one of the reasons for the current heavy Russian military and political pressure on Turkey.

Backbone of the U S. missile intelligence system is an AN FPS-17 radar developed and operated by General Electric Co. near Samsun, Turkey, a seaside resort on the Black Sea. This radar can detect and track missile firings from the main Russian missile test center at Krasnyy Yar (see map) on both the intermediate range extending to the southeast toward the Afghan border and the longer range track extending eastward on about a heading of 70 degrees to the Pacific Ocean in the area around Vladivostok in Siberia.

A similar radar set is operating at Laredo, Texas, (AW June 4, 1956, p. 23) where it is used to track ballistic missiles fired at the White Sands, N. M., Proving Grounds. Both radars have been in operation for several years.

These two radars are believed to be the most powerful sets now operating in the world. They develop a peak power of about two megawatts but radiate this power for a pulse about a thousand times longer than conventional radar. These sets now have a range of about 1,000 miles depending upon the strength of return from a target. They use a simple type of coherent integration developed at the Lincoln Laboratory, Massachusetts Institute of Technology to amplify weak signals occurring below the noise level of the receiver.

Both of these radars are being modified to increase their range to 3,000 miles at extreme altitudes as indicated by USAF Chief of Staff Gen. Thomas D. White in a recent speech (AW Sept. 30, p. 25). This modification will involve application of Columbia University's ORDIR (omnirange digital radar) technique to the AN/FPS-17 by the Federal Scientific Corp. which was recently founded by scientists of the Columbia University Electronics Research Laboratory.

The General Electric operated radar near Samsun has provided data on the type of Russian missiles being launched from the Krasnyy Yar test complex, their speed, altitude, track and approximate range. Data is automatically recorded and transmitted to the U. S. where data reduction is handled by the Lockheed Missile Systems Division and the Stanford Research Institute.

In addition to the radar equipment in Turkey, there are other approaches to gathering Russian missile data from outside the borders of the Soviet Union. One possible approach is via Project Tom Thumb, a USAF unit developed by the Hycon Manufacturing Co. of Pasadena, Calif., which is capable of detecting turbojet, ramjet and rocket engines at extremely long ranges and gathering fairly accurate data on the engine's performance. Another approach involves the use of optical equipment and spectometry to identify missiles and supersonic aircraft in flight. This is based on the well known fact that each different configuration of aerial vehicle produces a different air disturbance pattern in flight.

The Turkey based complex of U.S. missile detection and performance monitoring equipment has been yielding results for well over two years, dating back to the first test firings of the Soviet intermediate range ballistic missile from the Krasnyy Yar complex during the summer of 1955.

Fairly complete data on this missile test program has been obtained, including a significant shift from the irregular pattern of experimental test firings to a regular five per month pattern, indicating a switch to production line sample test firings during 1956. This provided fairly conclusive evidence that the Soviet IRBM program had shifted from the development phase to production with "operational" capability imminent.

Detection of the longer range, multi-stage ICBM test program along the 70 degree track toward the Pacific began in late 1956. A variety of shots was recorded, including stage separation tests, maximum altitude attempts and finally long range firings impacting about 4,000 miles from the launching site. Present radar can not cover the entire distance of the long range firing. These long range firings began during the early summer of 1957, and the Soviets publicly announced they had successfully tested an ICBM late in August (AW Sept. 2, p. 27). During the summer months of June, July and August, there were at least eight firings of long range multi-stage missiles of various types along the Siberian track. It is believed the Russians are using the same launching equipment for their Sputnik satellites as for their ICBM.

The long range missile firing frequencies, irregular intervals and variety of tests conducted indicate that the Soviet ICBM program is still in a development test stage with production and operational capability in this field still two or three years distant.

USAF made its first test firing at the Cape Canaveral, Fla., missile test center of a Convair Atlas ICBM last June, fired another propulsion test vehicle in September (AW Sept. 30, p. 30) and has a third shot scheduled for early November. Test firings of the Army's Jupiter and the USAF's Douglas Thor IRBMs began early this year.

Convair Wizard Wins

Washington—Convair Wizard air defense system has been endorsed by the U. S. Joint Chiefs of Staff for development by the Air Force as the prime future defense against all types of aerial vehicles, including intercontinental ballistic missiles. Convair's Wizard system was in competition with the Army's Nike-Zeus system developed by Bell Laboratories and Douglas Aircraft Co. and another USAF sponsored system involving Boeing Airplane Co., General Electric and Ramo-Wooldridge Inc. (AW Oct. 7, p. 29; Oct. 14, p. 37)

Joint Chiefs in making the Wizard decision also reaffirmed USAF's responsibility for area air defense in contrast to the Army's role of point defense.

Wizard proposal was developed by Convair in cooperation with Radio Corp. of America and other specialist firms as an overall long-range air defense system that would be effective against all types of aerial vehicles, including Mach 2 bombers, air-to-ground missiles and long-range ballistic missiles. It is based on both long-range detection devices and long-range defensive missiles using solid propellants and involves considerable advanced component development work on special antennas, electronic antenna steering devices and high power sources.

Among the component developers associated with the Wizard program are:

- General Electric on missile warheads.
- Sanders Associates whose PANAR multi-element, multi-lobe antenna system is being adapted for Wizard due to its relative invulnerability to point-source jamming.
- D. S. Kennedy Inc. working on problems of big parabolas.
- Avco Inc. electronic antenna steering devices.

Special high power sources are being developed by Rome Air Development Center, Radio Corp. of America and EIMAC. Wizard is still primarily in the design proposal stage and would require at least five years to provide early stage hardware capable of systems operation.

Soviet Technical, Political Gains Spur Shift in Attitude on Defense

By Evert Clark

Washington—Major shift in administration attitude on the defense problem was under way last week as a result of Russian technological gains and diplomatic maneuvers, and strong recommendations by the President's Science Advisory Committee that U S missile effort be increased.

Beginning of the shift was made clear in statements by Vice President Richard M. Nixon and Deputy Defense Secretary Donald A. Quarles only a few hours after the Advisory Committee met with the President.

Secretary of State John Foster Dulles said a day later that the nation's security must come first even if that means greater sacrifices in the form of bigger budgets and higher taxes. All three administration officials spoke seriously of Russia's satellite and its implications.

The night before the Advisory Committee visited the White House, statements by public officials were still in the vein of former Defense Secretary Charles E. Wilson's remark that the satellite was a "scientific trick." Assistant to the President Sherman Adams spoke of "high score in an outer space basketball game" in referring to the U S.-Russian satellite situation.

Adams also pledged that President Eisenhower, his administration "and indeed the Republican Administration that will succeed this one in 1960, will never weaken in their determination to hold to sensible budgetary and fiscal goals"—including "a balanced budget, a surplus sufficient to provide a tax cut" and continued payments to reduce the public debt.

'No Greater Mistake'

Nixon told a San Francisco audience that the U. S. "could make no greater mistake than to brush off this event (launching of Sputnik) as a scientific stunt of more significance to the man in the moon than to men on earth. We have had a grim and timely reminder of a truth we must never overlook—that the Soviet Union has developed a scientific and industrial capacity of great magnitude.

"Let us resolve once and for all that the absolute necessity of maintaining our superiority in military strength must always take priority over the understandable desire to reduce our taxes."

Quarles, speaking in New York, said: "As long as we are faced by the challenging threats of Soviet Russia, sacrifices will continue to be required in the form of individual effort, or unpersonal effort in the form of taxes, that are greatly in excess of any we have

previously been willing to devote to national security except during a shooting war.

Nixon, Quarles and Dulles all stressed that the military power of the U. S. is now considerably stronger than that of Russia. But all three said the rapid growth of Russian strength could not be ignored and should not be underestimated.

Re-Appraisal

President Eisenhower had said a week earlier: "Now, so far as the satellite itself is concerned, that does not raise my apprehensions, not one iota." He said its only significance was that it proved the Russians had powerful rockets, and it gave them a propaganda advantage.

Nixon called the launching a "spectacular event," and said it "will have rendered a signal service to the cause of freedom if only we react strongly and intelligently to its implications . . .

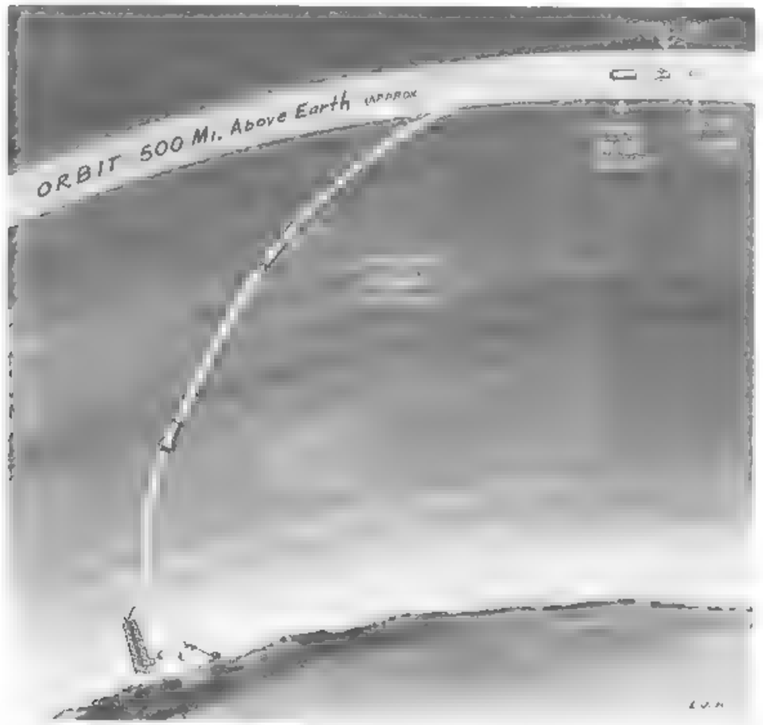
"No more dramatic incident could have occurred to remind both the Communist and the free world of the increasingly terrifying aspects of modern warfare," Nixon said.

This obvious re-appraisal of the situation was followed by a meeting between Eisenhower and his top financial adviser, Budget Director Percival Brundage. The night before Brundage went to the White House, he and Central Intelligence Agency Director Allen Dulles had minimized the importance of the satellite launching, and Brundage had remarked that it would be forgotten in six months. A dinner companion, former minister to Luxembourg Perle Mesta replied: "And in six months we may all be dead."

Shortly after the Brundage-Eisenhower meeting, the White House named Arthur Larson as Special Assistant to the President for "special projects in international affairs relating to United States informational programs and Soviet propaganda efforts." Larson also will advise Secretary Dulles on special overseas propaganda programs.

Until the new post was created, Larson was head of the U. S. Information Agency, which had reacted to the satellite launching by immediately sending a "news policy note" to its Voice of America radio network advising newscasters to avoid deprecating the Soviet satellite scientists, play down any idea of a satellite race between the U. S. and Russia, avoid linking Russia's achievement with her military potential, stress the scientific aspects of the Russian satellite and avoid a suggestion that its launching was evidence of "Soviet superiority in science."

White House Press Secretary James Hagerty declined to say whether Larson's appointment and naming of career diplomat George V. Allen to replace him at USIA were related to the Soviet satellite launching.



RUSSIAN sources report first stage of Sputnik rocket headed straight up for a mile, turned to a 45 deg. angle, reached 4,500 mph. Second stage reached 12,000 mph. and 625 mi. from launching site; third stage to 18,000 mph. orbital attitude.

Sputnik Rocket Size Alarms USAF

Washington—Air Force officials are deeply concerned by the size and apparent weight of the third stage rocket which carried the Soviet Sputnik satellite into its orbit. Detailed photographs of the rocket show enough details of the rocket to cause alarm. Next goal is to get similar detailed shots of the satellite itself.

Defense Muzzle

Muzzles on the three services were even stronger than the guidance to the Voice of America. Air Force, Army and Navy ordered their personnel not to comment publicly on U.S. or Russian satellite programs.

Wording of the Air Force and Army orders [illegible] left no doubt that the gag policy originated at the White House. Orders to all three services bore the same date, Oct. 9, five days after the launch.

At least one Air Force command, in transmitting the headquarters order down the line to its installations, worded it this way: "The President of the United States desires that Air Force personnel refrain from making public comment on satellite programs of the United States and other countries."

USAF's order was marked "For Official Use Only" when it was transmitted from Chief of Staff Gen. Thomas D. White to all commands. Copies of Navy and Army orders furnished to the House Government Information Subcommittee bore no label indicating distribution was restricted.

Chairman John E. Moss (D.-Calif.) said Defense Department officials will be asked where the policy was originated when they are called for public hearings on Nov. 18 and 19.

Army's order went to commanding generals of Air Defense Command, Army Ballistic Missile Agency, and Continental Army Command.

USAF Order

Text of the Air Force order as transmitted from USAF headquarters:

"Recent Soviet announcements have created much public interest and speculation. To endeavor to keep this matter in proper perspective, assure (that) all personnel under your jurisdiction refrain from making any public comment pertaining to missile or satellite matters at this time. Any comments almost certain to be misinterpreted. Discretion should be used in the implementation of this instruction."

Army's similarly worded order said "any statements . . . are subject to misinterpretation both here and abroad."

Navy's gag was not as tight—it allowed officers to quote a speech on the satellite situation made Oct. 8 by Chief of Naval Research Rear Adm. Rawson Bennett—and it held out hope that the gag would be soon removed.

"This notice will be canceled as of 1 December 1957," the Navy order read.

Russia meanwhile dropped its pose that its satellite was a symbol only of "peace and progress." The newspaper Leningrad Pravda printed an article saying Sputnik was capable of determining density of the atmosphere at various heights, and "this question is of immense importance for the development of modern jet-propelled guided missiles as well as for the conquest of the cosmos in general."

Clifford C. Furnas, former Assistant Secretary of Defense for Research and Development, joined the controversy over this country's Vanguard satellite project by saying he urged former Defense Secretary Charles E. Wilson more than a year ago to free more funds for Vanguard.

"It was quite obvious that the Russians were making progress, particularly in the rocket field, and I felt it important for our international relations that we be successful in getting a satellite up first," Furnas said.

But Wilson took a "so what" attitude, Furnas said, and the requests for more money "never got out of the Secretary of Defense's Office." Furnas said the President was correct in saying he never refused a request for Vanguard funds, because he never got one.

Furnas charged that funds for Vanguard came from various Defense Department budgets and arrived "in bits and pieces."

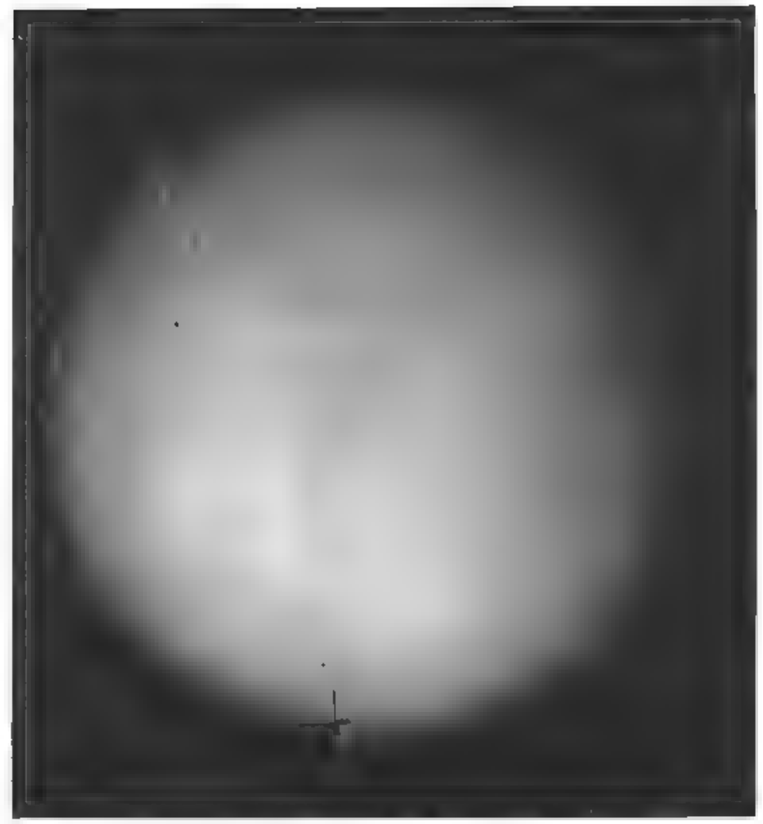
"There has been begrudging and dribbling financial support," Furnas said.

"There has been a great deal of fumbling, waiting for the other fellow to pick up the check."

New Missile

St. Petersburg, Fla.—Inertially guided air-to-surface missile is in development by Minneapolis Honeywell under an Air Force contract, the company disclosed last week at the opening of a $4,500,000 missile guidance plant here.

Missile, reportedly called Wagtail, probably is for use by fighter type aircraft and utilizes a relatively simple guidance system. Development is being carried out at the company's facility at Los Angeles.



FINAL ROCKET STAGE that boosted the Soviet satellite into its orbit is shown over Norwalk, Conn. Dashed trail results from multiple exposures. Each dash represents a three-second exposure. Photo is being sent to the Smithsonian Institution which may be able to make significant determinations of the rocket's speed based on the length of the dashes correlated with length of exposure. Photograph was made by two engineers of the Engineering & Optical Division, Perkin-Elmer Corp. at 5 58 24 a.m. Oct. 16. Camera mounted a 3-in. f 1 5 lens developed by Perkin-Elmer for aerial reconnaissance.

Presidential Assistant Adams, after denying that "our country has been in a pell-mell race to be the first nation in history to shoot something round into outer space," added, "At no time have dollar limitations of any kind held up our country's satellite program."

Vanguard program's TV-2 test vehicle was scheduled to be fired late last week to test the first stage engine, as the Russian Sputnik continued in its orbit.

IRBM Choice Waits More Test Firings

Washington—Defense Department decision to delay its selection of an intermediate range ballistic missile (IRBM) pending further tests is favored by both industry contractors and the Air Force.

Within a few hours after the postponement was announced, USAF's Douglas-built Thor made a second successful flight from its launching pad at Patrick AFB, Fla., and traveled more than 2,000 miles.

At the Pentagon, USAF and Defense Department observers agreed there have been too few test firings to justify action, despite the fact that former Defense Secretary Charles E. Wilson had hoped to settle the question before his retirement about 10 days ago. Neil H. McElroy, Wilson's successor, said upon taking office that the test program will be accelerated.

The recommendation to delay the decision was made by the three-man committee headed by William M. Holaday, special assistant to the secretary for guided missiles.

Other members of the committee are Maj. Gen. John B. Medaris, head of the Army Ballistic Missile Agency, and Maj. Gen. Bernard A. Schriever, commander of the Air Force Ballistic Missile Division. It was indicated that Gen. Schriever concurred in the delay, probably because he is confident that Thor will prove its reliability and accuracy in the current test program.

Details of Sputnik Surprise Scientists

By David A. Anderton

Barcelona—Soviet's successful satellite has tremendous technical implications that provide a bench mark for judging the state of Russian missile art

It underscores Russian ability to launch a nuclear warhead aimed at any part of the world

It confirms the existence, availability and to some extent the reliability of very-large-thrust liquid rocket boosters. It indicates the tracking frequencies and types of equipment used in the Russian long-range missile programs. It points to one of the firing areas used in the program

In a broad scientific sense, the Russian technicians have proved once and for all the feasibility of a satellite and of communications from such a vehicle Not too long ago, some competent engineers were inclined to dismiss satellites as science fiction; avionics experts occasionally questioned the possibility of getting data back across the reaches of space. These valid doubts have been removed.

Performance a Surprise

But it was the detailed technical performance of the satellite and its launching vehicle that provided the most surprises to the delegates at the Eighth International Astronautical Federation Congress here

Success or failure of a satellite launching is determined at the point in space at which the engine stops producing thrust. The trajectory from there on is determined almost uniquely by two factors: speed of the vehicle at the instant of motor burnout, and the angle of the tangent to the flight path with respect to a reference axis, generally taken through the center of the earth.

Flight path from then on can only be altered, in the case of a satellite, by the very gradual decelerating effect of the occasional molecule of air that hits the sphere and which, in the collision, slows the satellite The aerodynamics of extremely high altitudes was first discussed in AVIATION WEEK (June 25, 1956, p. 50).

Final speed at burnout of the last stage engine is proportional to two items only: the exhaust velocity of the rocket engine and the ratio of total vehicle weight to the payload weight.

Angle of departure of the flight path is determined by the overall accuracy of the guidance system in programming the flight path of the vehicle

Official Russian data on the satellite launching vehicle said it was a three-stage rocket. Launching was conventional, with the flight path programmed vertically for about one mile, then tilted over toward a 45-deg. trajectory. The first-stage engine took the vehicle to a speed of about 4,500 mph. before cutoff. The second-stage burning blasted the rocket to a speed of about 12,000 mph. before it burned out. The remaining third stage, which was made of the rocket propulsion unit, a nose shield and the satellite itself, coasted until the flight path was parallel to the earth's surface; then the rocket was fired. Final speed was about 18,000 mph., and the three objects—satellite, nose shield and third-stage propulsion unit were all in an orbit

This scheme is similar to that planned for the U. S Vanguard program, but it differs in cutoff speeds and altitudes.

From these numbers and the announced weight of the satellite—184 lb.—technical observers drew some very disturbing conclusions

They noted that both first and second stage burnout velocities are higher for the Russian vehicle than for the U.S. one, indicating higher mass ratios for those stages than planned for the Vanguard. Planned overall mass ratio (ratio of total launching weight to satellite weight) for the Vanguard is about 1,000 Put another way, it takes 1,000 lb. of structure, guidance and fuel sitting on the launching stand to put one pound of satellite in orbit.

Total weight of the Russian satellite and its protective nose cone is probably around 220 lb., or 100 kg. overall Mass ratio for the Russian vehicle can be assumed to be about that for the Vanguard. Obvious arithmetic indicates the three-stage Russian satellite vehicle weighs in at about 220,000 lb., which is 10 times the Vanguard gross weight

Thrust Estimate

Assuming comparable thrust ratios, then the thrust of the Russian rocket must be on the order of 270,000 lb., but might be as high as 300,000 lb. This could be obtained with a cluster of liquid-rocket booster units, or a single booster with clustered motors. Either way, the thrust of the rocket motors used would be between about 70,000 and 100,000 lb.

The lower figure is within the capacity of a developed motor the size of the German V-2 engine. North American Aviation, Inc., developed such a variation on the basic German engine and got about 76,000 lb thrust from it. The Russians could do the same

These numbers make it possible to construct a hypothetical rocket which has either three or four first-stage engines, a single second-stage engine of the same thrust rating, and a third stage which might be a modification or development of the Vietor rocket used in Russian IGY high-altitude work

First and second-stage engines probably were fueled by alcohol with liquid oxygen as oxidizer. This is the standard Russian combination used in a large portion of their missile work.

Third-stage rocket probably was solid-fuel for the same reason as the Vanguard: guaranteed ignition and combustion at high altitudes. It may have been a simple motor casing and charge fastened to the base of the Vietor rocket head

Performance of the satellite indicates the Russians had ample velocity margin to meet orbiting requirements The lack of any apparent amplitude modulation of the satellite signal indicates that the satellite itself is non-rotating, which in turn means that the last stage vehicle would not have been spun up before separation

Orbital Height Varies

The ellipticity of the orbit, which would be a measure of guidance system accuracy, has not been tied down with enough observations to make a solid assessment possible Official Russian statements said that the orbital height varied and was a maximum of about 621 mi. (1,000 km), but observations in Germany and England have placed it as low as 180 mi at its closest passage to the earth.

If the latter figures are true, then there is less atmosphere density at that altitude than formerly believed, because most calculations show a rather short orbiting life at altitudes below 200 mi.

None of the Russians at the International Astronautical Federation Congress here professed to know any details about the program, not even the launching site. They said that four different ones were available, and later reports have narrowed down the firing site to a spot somewhere north of the Caspian Sea. This covers a lot of Russian territory, but does narrow it down to a missile range in that area, used for the obvious advantage of the availability of logistic support

Possibly a Crash Program

There seems little doubt that this was a brute-force approach, achieved with off-the-shelf hardware. There is even some speculation that the Russians instituted a crash program with the Vanguard project as a spur. Observers remembered that almost every Russian announcement of their satellite program was made after a U S statement.

"All but one, that is," said one observer, "and that was the one that really counted"

Tracking frequencies were announced by the Russians before the firing, but only just before. The two chosen -20 and 40 mc.—indicate that the Russians adapted Doppler radar gear from their long range missile program and used it for the first shoot. Meantime, they have unofficially indicated that successive satellites will broadcast on the 108 mc. frequency

They have also unofficially indicated that this first shot was not a scientific satellite intended as a contribution to the IGY program, but rather a test firing to see if it could be done. Having done it, they seized the opportunity to make technical and propaganda capital from the firing.

Propaganda effort here extended to great lengths. The Russians were thoroughly charming, mingled with the delegates and even visited a religious shrine one day of the meeting. Alla Masevitch, astrophysicist chosen as the glamor girl of the party, showed up at one reception wearing a Spanish skirt, at another wearing Spanish shoes copied after a bullfighter's. She put on a new dress each day, two on some and three on one or two occasions. She showed pictures of her four year-old daughter.

By the last day, she—and the Russians—had almost every delegate eating out of her hand. The final touch was at the conclusion of her paper on Russian optical observation stations for the satellite program. After describing the tracking telescope, she unpacked one and presented it to Agrupacion Astronautical Espagnol, the host society

Some observers thought scientific objectivity was carried too far when every appearance of the Russians became a signal for handclapping. There were bitter comments when, on the evening of a folk-dance festival given to honor the IAF Congress, the Russians were greeted by applause deliberately started and sustained by a few Americans. A few minutes later Dr Theodore von Karman entered and in dead silence walked to his seat. Said one American, "If the Russians rate handclapping, von Karman rates a standing ovation with hat-throwing"

But the Russians continued to smile at every session, formal or informal. They made no comment that could be construed as rubbing in the accomplishment to their fellow scientists

Said one observer, "Khrushchev pointed out that they never talked about anything until they had done it I wish we had kept our mouths shut and our scientists off television and out of Life magazine until we had something to show for it."

Farside Aborts

Washington—Four attempts to fire a balloon-launched research rocket to a 4,000 mile altitude had failed by late last week in Air Force's Project Farside (AW July 22, p. 29). Two more attempts awaited perfect weather conditions.

First attempt, made at Eniwetok Atoll the day before Soviet Russia launched its satellite (AW Oct. 14, p. 27), failed when the 200-ft. helium filled balloon ripped. Second and third launch attempts followed at approximately two day intervals.

For 12 days after the first failure, USAF was not allowed to comment on firing attempts. Repeated inquiries and a published report of three of the failures finally produced a short press release.

Air Force said extremely low temperatures at high altitudes have had adverse effects on the balloon in each attempt, "with the result that the rockets have not been properly positioned to achieve the desired results."

In two attempts, the rockets were fired to obtain data even though maximum altitude could not be reached USAF said there have been no rocket malfunctions.

Farside is a $750,000 project sponsored by Air Research and Development Command's Air Force Office of Scientific Research. Prime contractor is Aeronutronic Systems Inc, a subsidiary of Ford Motor Co. Aeronutronic's team at Eniwetok included key scientists from all its departments and was headed by E. H. Krause, vice president in charge of research and development.

Farside rocket consists of four stages. First is four Thiokol Recruits; second is a single Recruit; third is four Grand Central Rocket Co. Arrow IIs; last stage is a single Arrow II containing a 3.5 lb. payload, which includes a telemetry transmitter. Instrumentation, developed by Aeronutronic and University of Maryland, was to measure earth's magnetic field in three of the six rockets and cosmic ray data in the other three.

Early Missile Hearings Planned

By Katherine Johnsen

Washington—Public congressional hearings on the U.S. satellite program and the related missile and rocket programs are expected to begin in the near future

Sen Mike Mansfield (D.-Mont.), the majority whip, said last week the groundwork study by the staff of the Senate Preparedness Subcommittee, a subcommittee of the Senate Armed Services Committee would be completed by the end of the month. He said he hopes hearings will begin "as soon as possible" after the study is completed and that "in view of the public interest they should be as open as possible"

The staff investigation was directed by Sen Richard Russell (D.-Ga.), chairman of the full Armed Services Committee, and Sen. Lyndon Johnson (D.-Tex.), chairman of the Preparedness Subcommittee It had the backing of Sen. Styles Bridges (R.-N. H.) and Sen Leverett Saltonstall (R.-Mass.), the top ranking Republicans on the Armed Services Committee (AW Oct. 14, p. 31).

Special Session Unlikely

It is unlikely, however, that the special session of Congress, which was urged last week by Sen. Stuart Symington (D.-Mo.) to focus public attention on the satellite issue, will develop

At a press conference urging the special session, Symington not only called for an all-out effort in the U.S. satellite and guided missile programs but also in the conventional aircraft and weapon modernization programs of the three services. Two key recommendations made by Symington:

- **Bans on overtime pay** in missile programs should be lifted. "Few people know that our ballistic missile programs have, for a long time, been limited to a five-day week," Symington said. "Conversely, when our military people went to Moscow last year, they were told that, once the Soviet political leaders had decided on a weapon, the only limitation to the development and production of that weapon was the sleep required by those who were working on it."
- **Air Force's proposal** for self-financing by defense contractors should be dropped. Symington said the plan whereby contractors would borrow money "to the tune of hundreds of millions of dollars" and absorb the cost of interest is "creating chaos in the manufacturing field" and is dictated solely by "the rigid and arbitrary $38 billion ceiling" the administration has placed on Fiscal 1958 defense expenditures

Symington estimated that Russia would have an operational intercon-

tinental ballistic missile within two to three years. He set the date for the U.S. at four to six years, but added that, under present cutbacks and stretchouts, the date would be pushed farther forward, and the U.S.-Soviet gap increased.

Over the past two years the Soviets have flight tested at least 20 times as many intermediate and short-range ballistic missiles as has the U.S., and months ago they successfully propelled and guided longer-range ballistic missiles on test flights from one end of Asia to the other," Symington said. "We have yet to launch one ICBM ... of sight ... it was launched."

He estimated that the Soviets "already have intermediate range ballistic missiles in sufficient numbers, and possible operationally useful enough, to successfully attack targets within the limits of that range."

Satellite Criticism

Symington also criticized the U.S. failure to correlate its satellite and missile programs. He said:

"It is . . . a fact . . . that the system which is planned to launch our 20 lb. Vanguard satellite next Spring is in no way related to, or capable of being used for, launching hydrogen warheads, as is the Soviet system which has launched a satellite many times larger than our planned satellite."

It should be understood, Symington added, "that while the Soviet satellite is a direct by-product of their ballistic missile system, our own planned satellite is not related to our ballistic program—and therefore even when fired will not be an indication of our progress versus the Soviets in the development of ballistic missiles."

Political Battles

Despite emphatic public avowals of non-partisanship by both Republicans and Democrats, a congressional investigation of the satellite and ballistic missile programs appears inevitably destined to become heavily enmeshed in politics. Developments indicating this were:

• **Statement by the Publicity Division** of the Democratic National Committee criticizing "the complacency of this administration in thinking that the Russians are not first-class scientists and applied engineers. . . . It is a shock to us that the Russians have beaten us by making the first ... earth satellite. . . . The people should be told the facts." The statement was signed by former President Harry Truman, former presidential candidates Adlai Stevenson, New York Gov. Averell Harriman, and other members of the Democratic Advisory Council.

• **Sen. Clifford Case** (R.-N. J.), indicating a general trend of Republican reaction, called for increased attention to military requirements—but defended the administration's approach of a steady level defense program for a long pull. "There are worse things than not being first," Case said. "Far worse would be to forget, as we have at times come dangerously close to forgetting, that ... of our security requires sustained, consistent effort for as long as we can presently see into the future."

Nuclear Hold Back

Washington—Sen. Henry Jackson (D.-Wash.) charged the Bureau of the Budget last week with holding back Atomic Energy Commission's program for nuclear propulsion of rockets. In the Fiscal 1957 budget, Jackson said, Congress voted an additional $9.1 million to AEC's $25 million request. As of last Jan. 28—after seven months of the fiscal year had passed—he said the Budget Bureau had failed to release $8 million of the $9.1 million.

Sealed Fuselage, Floats Turn Vertol HUP-2 Into Amphibian

College Point, N. Y.—Vertol Aircraft Corp. HUP-2 research helicopter has been made completely amphibious by reinforcing and sealing the bottom of its fuselage to act as a hull, adding outrigger floats for lateral stability on the water, and re-ducting the engine cooling system to avoid water ingestion.

Recent test flights made by Philip Camerano, Vertol test pilot, proved the modification to be successful. Flights were made in Flushing Bay near the plant of Edo Corp., which was given conversion contract by BuAer.

Vertol officials think that the Edo modification has great significance. Some believe that all future helicopters built for the Navy may include a requirement for waterproof hulls.

Vertol is currently building four Model 44 improved H-25s for the Swedish Navy with amphibious hulls and special lateral stability floats designed by the company.

Dual benefits expected from amphibianizing the HUP-2 are:

• **Increased capability:** By being as capable of operating on smooth to moderately rough water as equivalent-sized seaplane, research HUP-2's capability is greatly increased. It can land beside ditched aircraft to rescue crew, can land alongside ships to take on or off-load passengers, emergency cases or supplies. Being able to taxi forward or backward and pivot in very small radius (around one float) gives helicopter excellent water maneuverability. Additional weight of approximately 350 lb. resulting from conversion is about compensated for by increased lift due to greater ground effect caused by rotors being closer to water when craft is waterborne than is the case on ground during land operation. Pilot has not been able to induce any rotor ground resonance in flight tests to date.

• **Increased safety:** All over-water operations with amphibious HUP-2, such as plane guarding during carrier take-offs and landings, anti-submarine warfare, area weather surveying, etc., personnel and aircraft will be much safer because of single-engine machine's ability to land, even under autorotation, safely on sea in event of power loss or mechanical difficulties. Standard HUP-2s sink quite rapidly if ditched and have drowned passengers and crew.

Edo was given the contract to convert the HUP-2 into a full-fledged amphibian because of the difficulty of landing helicopters equipped with existing rubber floats at relatively high forward speeds—an important consideration during a forced autorotation landing. Rubber floats also have limited seaworthiness.

In initial Flushing Bay tests, the amphibious HUP-2 was landed at forward speeds of up to 30 kt. in 1½ ft. waves, and taxied at 15 kt. through a 2½ ft. steamer wake. Machine was successfully taxied up wind, down wind and cross wind. It proved that it could taxi backward without difficulty and make 360 deg. turns, pivoting on one float, despite a wind of 12-15 kt. velocity which was blowing during the tests.

Edo engineers found, from the HUP-2's load water line, that the helicopter floated almost exactly in flight attitude, the draft varying from a few inches at the bow to about 15 in. at the rear pylon.

Modifications Edo accomplished on the helicopter included:

• **Relocation** of engine-cooling air exhaust from trapezoidal opening under fuselage to two louvres at either side of new engine hatch.

• **Baffling of cooling air intakes** to keep out spray and engine exhaust.

• **Rotating** engine combustion exhaust stack 40 deg. upward.

• **Providing** completely new engine hatch cover for top of engine compartment just forward of rear pylon.

• **Installing** two floats, one on either side of center of machine. Floats are remodeled forebodies of standard model 89-2000 Piper Cub floats. Aft end was faired into a pointed V shape to ease backing operations on water. Determination of size of outrigger floats necessary to produce required lateral stability was based on Edo's considerable background in hydrodynamics.

• **Reinforcing** bottom of the fuselage to withstand impact with water at maximum sink speed of 4 ft./sec., which is well within HUP-2's autorotation capabilities.

• **Installing** foot-high dam at bottom of passenger door entrance.

• **Replacing** lower Plexiglas windows in cockpit with aluminum plates to provide sufficiently strong bow for hull.

• **Waterproofing** entire bottom fuselage to line six inches above load water line with Fiberglas, and gasketing all access doors in the hull.

• **Replacing** magnesium main landing gear wheels, which cannot stand corrosive action of salt water, with aluminum wheels. This was only modification made to standard undercarriage.

• **Protecting** against gasoline spillage and fumes by installing catch basin in bilge. Bilge pump and ventilating blower were installed to eliminate fuel and fumes. As added precaution, gasoline fume detector or "sniffer," which actuates indicator mounted above instrument panel in cockpit, was also included in bilge to warn of presence of fumes in engine compartment.

C. L. Fenn, Edo's chief engineer, told Aviation Week that the same type of "amphibianization" could be performed on single-rotor helicopters. Preliminary studies indicate that Sikorsky's S-56 twin-engine helicopter has an excellent load water line.

When the HUP-2's flight tests are completed at Edo's plant, the helicopter will be flown to the Naval Air Test Center at Patuxent NAS, Md., for further evaluation.

AMPHIBIANIZED Vertol HUP-2 helicopter hovers a few feet above Flushing Bay in initial tests of its waterproofed hull.

FLOAT-EQUIPPED HUP taxies on water in Flushing Bay.

News Digest

Dassault Mirage III fighter reached speed of Mach 1.8 in level flight. French fighter, powered by SEPR rocket and Snecma Atar turbojet, was piloted by Roland Glavany during test flight from Melun-Villaroche.

Douglas Aircraft Co. released 400 office and clerical employes at its El Segundo division. By January 1, personnel force will be reduced to a 70,000 total.

Pilot's Picture Tube Display Test Flown

By Richard Sweeney

Los Angeles—Basic contact flying analog units in Army-Navy Instrument Program (ANIP) for integrated cockpit development were unveiled here last week at a symposium sponsored by the two services, Douglas Aircraft's El Segundo Division and Bell Helicopter Corp.

Basic units now being flown in a T2V-1 are:

- **Flat cathode** ray tube which gives symbolic display of attitude, speed by means of a series of grid lines much the same as pilot would see flying over farms with section lines.
- **Lightweight airborne** digital computer which takes information from sensors, sends computed data concerning attitude, rates.
- **Display generator,** link between computer and cathode ray tube which turns computer's output into electronic signals which give pilot his information on flat tube.

To better test concept of contact analog, a simulation of the proposed situation display has been fabricated and installed in the T2V-1. The moving element consists of a simulated airplane shaped light, movement of which is controlled by manual inputs from the cockpit. This moving element traces airplane path on a semi-transparent map of the Southern California area. Final configuration of situation display will be a cathode ray tube showing airplane position automatically according to data from computer, which in turn will get raw information from available navigational aids and or inertial type stable platform.

Flying test bed so far has six flights totaling 3.6 hr. actual flight operation time for the equipment.

In the T2V-1, test display is mounted in front cockpit, with cathode ray tube shaped to completely fill normal front windshield area. Presently, a hood covers front of display tube, precluding normal flight operation from front cockpit. Rear cockpit is standard, and James Stegman, Douglas project test pilot, acts as safety observer while person in front cockpit is flying under hood using the new display.

Pilot Flight

So far, only one pilot has flown with the display tube. All other flights have been by engineer personnel.

In addition to large numbers of military and industry personnel at the symposium, many airline officials also attended the classified sessions. One major aim of the meeting was to apprise carriers of what should be available for operational use at the advent of jet transports, so that those airlines wishing to incorporate an integrated cockpit may make provisions for it in their planning.

Information declassified and research data gathered in the program was formally turned over at the meeting to M. G. "Dan" Beard, American Airlines official and chairman of the SAE Air Transport Activities Branch Aircraft Cockpit Standardization Committee. The committee aided in preparing the standard for transport cockpit instrument locations which soon will be a fully operational part of Civil Air Regulations.

Although the ANIP program is not new and all components have been considered at length in the three annual gatherings which preceded this one, this was the first meeting at which flying hardware existed and was on flying status in an aircraft.

Basically, the concept calls for blind flight presentation to the pilot on a flat, transparent cathode ray tube, of a picture analogous to what he would see while flying contact. Additionally, information he formerly had to gather from a number of dials, and mentally integrate before making decisions, is presented in already-integrated form. Concept went back to basic requirements for safe flight, that is—"what am I doing, what should I be doing, what do I do to be doing the right thing?" and will provide answers to these questions which leave a minimum or no integration for the pilot but, instead, frees him for decisions.

Data Transmission

In the T2V-1, sensors pick up pressures and temperature for computation and presentation to the pilot for altitude and airspeed information. Stable platform information for attitude is provided electro-mechanically by a sphere with converging lines painted on it, and flying dot scanner. Movement of the sphere about its axes gives the computer information concerning attitude, and movement of the lines to simulate flight over farm section lines is provided by the display generator.

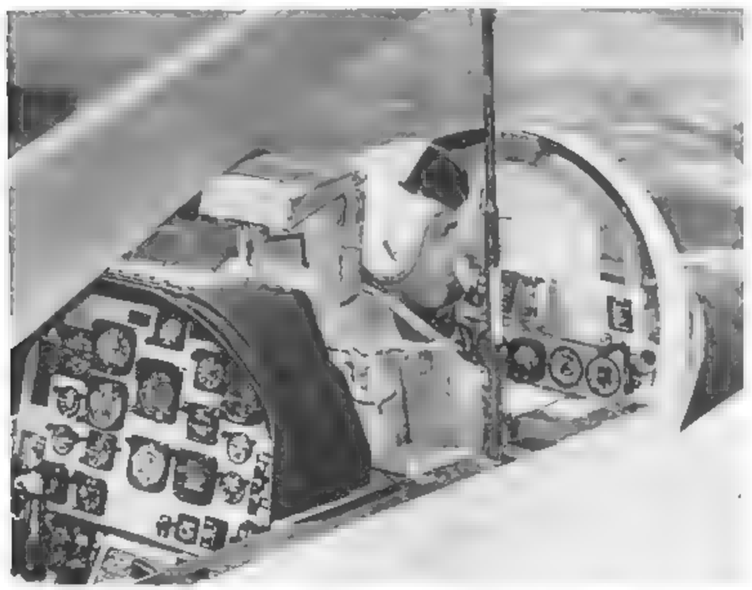
Presently mounted on the T2V-1 are two movie cameras, one recording forward movement, the other over the pilot's shoulder filming the cathode ray tube. As flight test progresses, cameras will be operated simultaneously to correlate what is happening outside the airplane with the display showing on the tube.

In addition to integrated information being displayed in T2V-1, row of dials below cathode ray tube shows basic information in backup form, airspeed, altitude, fuel, engine data.

Attitude information now being presented by electro-mechanical unit soon will be supplanted by an all-electronic unit being developed by Kaiser Electronics.

Kaiser is due to have hardware flying in this portion of program within about six months.

Bid call for new display generator



SIMULATION of proposed situation display installed in front cockpit of T2V-1

(AW Sept. 23, p. 23) incorporates more sophisticated requirements than that now flying, in that it will have take more information from the computer and show it on the tube. While converging grid pattern shown on tube serves well presently, a tendency for pilot fixation has been noted in extended operations with this optical presentation. It is anticipated that a random pattern display which may appear more like flying over natural earth scenery like desert, farms, cities, mountains, will have less tendency to lead to fixations, will be more comfortable psychologically, and will probably be incorporated in the new generator.

While overall theory calls for simplicity and for minimum pilot ability to fly safely, concept calls for incorporation of fine numbers information necessary for close margin flying such as is accomplished under emergency conditions, in test work. Standby emergency conditions also will be provided for.

Contractors on the test bed hardware are Kaiser Aircraft and Electronics Corp. who built the tube, other electronic components of the system; Servomechanisms, which helped fabricate the sphere, DuMont Laboratories, which developed the display generator.

While current hardware is relatively unsophisticated, Army-Navy Instrument Program leaders see no reason why final configuration and capability hardware cannot be developed and brought to operational usability status in a few years if enough support is given.

Fixed wing instrumentation hardware is further along than that being developed for rotary wing aircraft under the leadership of Bell Helicopter Corp. However, development of necessary components of system for fixed wing application demonstrate that no breakthroughs are necessary to bring the rotary wing program along to comparable status, and Bell now has a cathode ray tube unit mounted in a helicopter simulator at its Ft. Worth plant. Problems of helicopter contact analog presentation are more intricate, with the aircraft's greater freedom of movement about various axes and in flight paths.

Army-Navy Program has Douglas Aircraft as prime contractor for fixed wing system, Bell for rotary wing. Numerous subcontractors have participated in studies of hardware for both systems. Office of Naval Research directs the program, with Cdr. George Hoover as officer in charge of the project. Al Mayo is Douglas Engineer guiding the program, Owen Niehaus is Bell project chief.

USAF Surveys Cost Estimates; Still Further Cutbacks Planned

By Claude Witze

Washington—U. S. aircraft industry was preparing last week to survive the shock of new cutbacks, the magnitude of which were still being determined at highest-level USAF and Navy conferences.

There were strong indications that the Air Force itself was jolted by industry billing estimates for the remainder of Fiscal 1958. Due at Air Materiel Command Headquarters by Oct. 10, the figures were at Pentagon headquarters early last week for scrutiny by USAF Secretary James H. Douglas, Assistant Secretary Dudley C. Sharp and their uniformed counterparts, headed by Lt. Gen. Clarence S. Irvine, deputy chief of staff, materiel.

Earlier estimates that the industry will suffer cutbacks of not less than 14% (AW Oct. 14, p. 33) were being viewed as conservative. Some aircraft industry representatives in Washington were speculating that the slash may go as high as 20% or 25%.

Reaction to an early USAF suggestion (AW Oct. 7, p. 30) that production schedules be maintained but billings postponed until the next fiscal year was becoming increasingly cool in industry circles. It appeared that a new wave of cutbacks, to hit the industry in November and December, is the only solution to USAF's problem of staying within the administration imposed spending ceiling.

There are reports that many contractors, ranging all the way from a major engine producer to construction firms working on missile test facilities at Patrick AFB, Fla., will refuse to finance government purchases.

In the aircraft and related industries, the argument against such a policy is simple: We can't borrow money at 5½% at our own expense to carry out a contract on which the profit margin is 3% or less.

More Layoffs

The situation in regard to suppliers and subcontractors made it clear that no action by the 28 major contractors initially approached by USAF for "put it on the cuff" purchasing can solve the problem for the Pentagon and Air Materiel Command.

No effort by a prime contractor who is willing and able to provide financing for USAF deliveries will keep the production line going if his suppliers are unable to keep operating without financial relief. Anticipated payments from the government have to be maintained in complete phase if the weapon system components they buy are to arrive on the assembly line in time to make delivery possible.

Orval R. Cook, president of the Aircraft Industries Assn. and a former USAF deputy chief of staff for materiel, put no yardstick on the size of the anticipated slashes. But he did anticipate that work loads will be reduced with additional layoffs of personnel, "perhaps heavy ones.

"We expected a gradually declining rate of production, but we are in the midst of what we consider to be a sudden drop, with little time to adjust to it.

"It has all happened over the last three and a half months. Nor are the full effects known. We shall just have to wait and see."

Five Day Week

With a single exception, there was no sign from top administration leaders that there will be any softening of the firm stand for a $38 billion ceiling on defense expenditures. Even the ballistic missile programs remain on a five-day week both in industry and the military.

Russia's spectacular success in launching the Sputnik satellite was generally disclaimed by the administration. A sense of urgency was voiced only by Vice President Richard Nixon, who said, "The absolute necessity of maintaining our superiority in military strength must always take priority over the understandable desire to reduce our taxes."

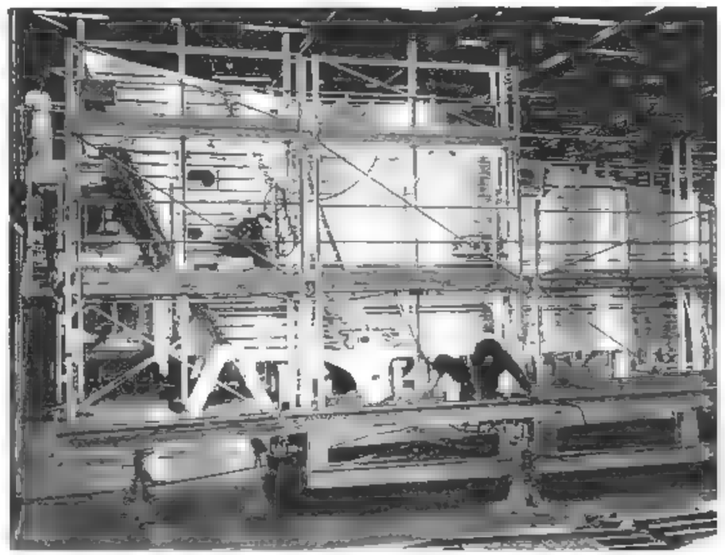
Nixon further spoke at odds with President Eisenhower and other political chiefs by saying Sputnik has military significance and cannot be "brushed off" as a scientific stunt.

There was wide speculation in Washington over the possibility that a break in the $38 billion ceiling would be forced by political reaction to the Soviet satellite. There was small hope expressed that anything will happen in time to save the aircraft industry from the impending cutback this fall.

On the other hand, there will be a congressional inquiry into the status of our defense program and the damage done by Eisenhower administration fiscal policies (see page 31). There is strong expectation that the military chiefs, or at least USAF spokesmen, will hold back no facts if they are called to Capitol Hill. In the past, there has been some reluctance to emphasize failings that would lead to serious clashes with the political administration. This reticence now may end with the uniformed witnesses providing more fully honest, and damaging, testimony on the state of their military machines.

WINGS of Boeing 707 airliners and KC-135 tankers for Air Force are joined to fuselages on production line above. Plane in foreground is second production 707. Behind it are KC-135s. Landing gear units also are attached on this line before the jets are moved to final assembly areas. Tankers are in service with Strategic Air Command.

Boeing 707s Are Assembled On Line With KC-135 Tankers



SEALANT is applied to 707 wing interior in sealing area (above). Operation turns the wing into a leak-proof fuel tank. The plane pictured is scheduled to be in commercial service by mid-1959.

JOINING line is seen from opposite end (left). The second production 707 airplane is at far end of the line with KC-135s in foreground. Pan American World Airways is the customer for this airplane. At left in background of picture is final assembly area for KC-135s.

IATA Members May Renew Fare Drive

Miami delegates feel boost in first-class rates may help offset mounting costs encountered by airlines.

Miami Beach—Renewed drive for a 5% first-class passenger fare increase gathered momentum last week among delegates to the International Air Transport Assn. traffic conference as the three-week sessions closed in deadlock over the third-class fare issue.

Chief reason for the deadlock was disagreement on how austere the third-class or thrift fare should be. Delegates were in full agreement that the low fare should be introduced on North Atlantic routes in April, 1958, in accordance with the rate structure approved by the traffic conference at Cannes in 1956 (AW July 2, 1956, p. 37). For this reason, the present conference will be resumed in Paris on Nov. 19 to allow delegates a "breathing spell" in the discussions.

The move for a fare increase was prompted by airlines who felt the proposed lower rates must be offset by higher first-class rates as the only means of keeping pace with mounting airline costs. This group will undoubtedly offer a resolution calling for a 5% increase in first-class rates to accompany a lower tourist fare and a still lower thrift rate.

Possible Roadblock

Strong doubt existed among a number of delegates that any move for a higher fare will meet with approval by the Civil Aeronautics Board. They point to the Board's firm position in blocking a request by U. S. domestic carriers for a 6% interim fare increase and question any likelihood of the Board reversing its equally firm stand on the North Atlantic first-class fare structure.

The Board in its decision on international fares stated that extraordinary increases in costs should be met by means other than fare increases and suggested to IATA members that North Atlantic operators failed to utilize maximum capacities of their aircraft.

Proponents of the proposal to make a second attempt to get a fare increase believe CAB may be more sympathetic toward a request for a 5% rate hike if such an increase is confined to a first-class rate and does not include the two lower fares. Such a structure, they say, will provide additional revenues needed by the carriers without discouraging the normal traffic growth attracted by low transatlantic fares.

Large airlines expressed concern that a third-class rate, coupled with a tourist fare that would include at least some fringe benefits to passengers, might drain a substantial portion of first-class traffic from North Atlantic operations. It is this group that wants to introduce a third-class service obviously inferior to tourist service and a tourist service that will be unattractive to passengers who can afford the first-class fare.

Smaller airlines opposed this strong line of distinction between the three fares and pumped hard for a two-tier fare structure with a first-class fare and a thrift fare that includes some extras for the passenger. Smaller airlines operating a low frequency of schedules are not likely to benefit from a third-class fare to any great degree since the chief gain from such an operation is derived from a high-density traffic flow.

In addition, smaller carriers do not have the equipment to accommodate three types of traffic. They would be particularly hard hit if conditions for each fare level required drastic modification of seating configuration. It is not feasible to expect that carriers with small fleets would be inclined to apportion each aircraft into three different seating arrangements.

An attempt was made to bridge the gap between these two divergent views by proposing the introduction of a 23 day excursion rate similar to the present interim 15-day roundtrip London-New York $425 fare as the only condition behind the third-class rate. The proposal became bogged down in a debate as to whether such a rate should be conditioned to 23 days or 15 days and was finally dropped.

Passenger Benefit Dispute

On the issue of passenger benefits, large carriers again held opposing views to those of the smaller lines. The larger companies wanted to either give thrift passengers no extras or to set a minimum cost of 25 cents on each giveaway. Smaller carriers proposed a more generous attitude toward passengers on this point and wanted a less austere service for their thrift-fare customers.

Variances existed on whether liquor should be sold to thrift-class passengers and on the quantity of food which should be made available to them for sale.

Carriers not directly concerned with the thrift-class fare expressed concern that the low fare might later spread to other international routes where low-density traffic would not justify the three-level fare. It was this group that fought strongly against a closing of the conference without reaching some decision, since they felt the entire rate structure would be weakened by failure to adopt a set standard of rates on the North Atlantic routes.

The conference almost stalled completely on Oct. 11 when the group studying the thrift-fare proposals announced that the wide differences prevented even a compromise solution to the issue. Delegates voted to continue the discussions in another attempt to

Proteus Engine Trouble Found

New York—Bristol Aeroplane Co. is shaving .010 in. off the compressor blades in Britannia's Proteus 755 engines to fix trouble that caused forced shutdown of two engines last month during a BOAC proving flight over Florida (AW Oct. 7, p. 39).

Bristol says the incident unrelated to problems with earlier Proteus 705 engines in Britannia, was caused by contraction of the compressor casing. The BOAC Britannia 312 had sought out the meteorological conditions that were associated with icing difficulties of the 102 series in a flight to Miami.

Cold ram on the hot outer casing of the compressor in severe turbulence and precipitation caused it to contract, setting up friction between the casing and the blades and raising tailpipe temperatures. Two engines were shut down and the aircraft landed at Miami.

Bristol told Aviation Week that performance of the engine will be affected only slightly, if at all, by the modification.

Company believes it has a permanent solution to the icing problem, attributed to a bend in the engine intake duct where ice may collect under certain conditions.

Announcement of the modification is expected to be made shortly. Civil Aeronautics Administration will not certificate the Britannia until a satisfactory permanent fix is made.

break the deadlock, and the sessions were resumed on Monday. By Wednesday, however, it was clear that no progress was being made and the conference chairman, Gordon Bann, Northwest Airlines vice president of sales, announced that the sessions would continue throughout the remainder of the week to handle other matters but that further debate on the thrift fare would be postponed until the Nov. 19 session in Paris.

Bane emphasized that general agreement to start the new low fares in 1958 existed but that lack of unanimity on conditions of service to be provided and the relationship of North Atlantic services to services in other areas caused the postponement. He explained:

"The airlines concerned have decided that a breathing spell in the negotiations is advisable because of practical difficulties involved in determining service patterns on the North Atlantic routes."

Some airlines felt the inability to reach an agreement during the Miami Beach conference may have a deterring effect on bankers who plan to underwrite the purchase of jet transports and other fleets of new aircraft. They pointed out that financial circles may now hesitate to back the industry that has failed to agree on its exact revenue requirements in order to expand service and obligate itself to huge funds for re-equipment purposes.

Many international airlines have viewed the thrift-class fare structure with skepticism and apprehension since the rates were first proposed in 1956. These carriers questioned the commercial wisdom of offering an even further rate reduction at a time when increasing repetitive tourist traffic was beginning to spread revenues thin.

Most airlines agreed at the Cannes meeting that adequate time would be required to provide for technical and cost studies before any conversion to the three-level rate structure could be considered practical. Consequently, April, 1958, was chosen as the compromise target date for the introduction of the fares.

Delegates to the Miami Beach conference now generally feel that an open-rate situation has been avoided by the postponement of the sessions and that the outlook for some agreement on the issue appears brighter than it has at any time during the present meeting. They believe that the cooling-off period will mollify some of the extremists and permit more give-and-take than has been evident in Miami Beach.

Mackey Fills in on National Route

By Ford Eastman

Washington—Mackey Airlines was granted temporary authorization last week to provide air service between Key West and Miami for the duration of a strike that forced National Airlines to suspend operations Sept. 22.

An exemption order was issued by the Civil Aeronautics Board over the objection of National, permitting Mackey to provide service between the two points because of the "unique situation."

CAB said that in the past the Board has refused to grant applications for exemption authority in cases involving suspensions of service due to labor disputes. It said, however, that the situation was unusual because:

- **City of Key West** has no scheduled air service in the absence of service by National.
- **Key West** lies at the far western end of an archipelago that is linked by an overseas highway that would become impassible in the event of hurricanes and, therefore, in an emergency its only surface transportation could easily fail.
- **There is no rail service** between Key West and Miami.
- **City of Key West** is isolated from needed scheduled air service in Miami by over 145 miles.

The Board said, where there are adequate substitute transportation facilities, it has refused to alleviate a temporary suspension of air service by any one airline. It added that, because of the uniqueness of the Key West situation, the granting of Mackey's application does not constitute a departure from this policy.

National Opposed

National Airlines opposed the granting of the exemption authority on the grounds that the remedy to the situation is within the sole jurisdiction of the U. S. National Mediation Board and the President.

After the exemption order was issued by the CAB, Alexander G. Hardy, senior vice president, said National still contends the Board action is in error, but the airline will not challenge the issue in the face of assurances by the CAB there would be no further exemptions issued.

Earlier, CAB denied applications by Pan American World Airways and Pan American Grace Airways to provide service over the New York-Miami segment in order to continue through service to South America.

Also, last week United States Overseas Airlines, a supplemental carrier, applied to the Board for exemption authority to operate over National's route between New York and Miami.

The airline said it is a member of the class of air carriers specifically designated by the Board for the performance of supplemental air transportation in the event of an emergency to serve whenever and wherever the demand exists.

The airline argued it would provide no service which would be new or competitive by filling the gap left by National. If there is no present need for USOA's service on National's route at this critical time, it added, then there is no further need for National's service.

Increases Reported

Eastern and Northeast Airlines operate regular schedules between New York and Miami. Both have reported increased load factors due to the National strike but neither have increased service over the route at the present time.

National's operations were not completely suspended by the strike involving a labor dispute between the airline and the Air Line Agents Assn. It continued to operate flights between Buffalo, N. Y., and Washington and on to Miami because of an interchange agreement with Capital Airlines. The airline is also engaged in military charter movements.

Supplement carriers see their participation in this travel has dropped 10% in the first 10 days of October, while the scheduled carriers participation has increased 10%. They said, however, that they did not know how much of the 10% increase could be attributed to National's participation in the market during the strike.

Japan Air Lines Starts Expansion

Tokyo—Japan Air Lines will begin the first phase of its long-range expansion program in early March with the introduction of DC-7C service on its Tokyo-San Francisco route.

Delivery of the four DC-7Cs on order in early 1958 will permit the airline to increase the frequency of its transpacific service from five flights a week to seven and will release present equipment for inauguration of its San Francisco-Sao Paulo-Rio de Janeiro route next summer.

The program also includes the extension of routes to Europe sometime within the next two or three years, according to Seiiro Yanagita, president of the company. Although a polar route from Tokyo to Amsterdam is not included in present plans, the airline hopes to begin such a service once the earlier phases of its program have been implemented, Yanagita said.

The airline has four DC-8 jet transports on order and plans to increase the number to eight during the next 10 years. Yanagita said that 75% of the cost of the new equipment will be financed through the Export-Import Bank.

The carrier has enjoyed unusual success on its domestic routes despite the fact it carries no military traffic. However, it has no competition over the some 1,000 miles of domestic routes and is experiencing a marked swing from surface to air travel among Japanese businessmen and tourists.

Load factors throughout the year average 75% on the domestic service, and during the summer seasons they often rise as high as 90%. Yanagita said the airline earned a net profit of $3 million in 1956.

Transpacific service began in February, 1954, after the signing of a bilateral agreement with the U.S. in 1953. Service was inaugurated with two DC-6As purchased from the Flying Tiger Line and one DC-6A purchased from Slick Airways. The planes were converted to DC-6Bs.

Yanagita says he has no immediate intention of seeking any large-scale revisions of the existing U.S. bilateral agreement but conceded that he may discuss the possibility of traffic rights through the U.S. at a later time. He said he is not interested in Seattle as a port of entry because of the limited connecting business generated through there for the Far East. On the other hand, he added, Los Angeles would increase the airline's traffic potential if used as a port of entry in association with San Francisco.

Yanagita said JAL is not considering any plans to extend routes into Red China.

He emphasized that travel to the Communist country is extremely limited and would not justify the cost of such an operation.

More Records

Moscow—Russia says its Tu-104A twin-jet transport has now smashed all records for smashing aviation records.

The Soviet reports say the airliner's latest feat was to carry a 22,050 lb. payload for 1,000 kilometers over a closed course between Moscow and Orsha at an average speed of 604.144 mph. This is said to exceed the 1,000-kilometer speed records for no load set by Sweden, for a one-ton load set by the U. S. and for two, five and 10-ton loads as well.

Russian officials say that altogether the Tu-104A established 12 world's records during two weeks in September (AW Sept. 30, p. 33).

This does not include the record for smashing records.

Pan American Tests New Insignia

Dressed-up DC-6 of Pan American World Airways wears a white ball on blue-painted tail in configuration the airline may adopt fleetwide. Plane was painted with the new insignia to try it out. Other markings also are different: lettering style of "Pan American" on side of fuselage has been changed and "World Airways" dropped. Nose striping is blue.

House Group Begins CAB Hearings

Washington—A special House Commerce Subcommittee last week began hearings designed to crack the "Iron Curtain" it claims Civil Aeronautics Board has lowered on an investigation of the controversial North Atlantic and Great Circle route cases.

Rep. Morgan Moulder (D.-Mo.), chairman of the special subcommittee, has charged that a staff notice issued by the Board detailing the extent to which cooperation should be extended to congressional investigators "is without basis in precedent or law" and tantamount to a "refusal" to permit the subcommittee to make its investigation (AW Oct. 14, p. 41).

At the beginning of the hearings, however, CAB backtracked on one point of issue and reluctantly agreed to make available staff memoranda.

"To have mental processes and recommendations of staff members subjected to public scrutiny, misunderstanding and even ridicule would open a serious breach in the administrative process," CAB Chairman James R. Durfee testified.

"The staff member faced with possible consequences of such exposure to political recrimination or industry revenge could only retreat by remaining mute. Such a staff would become a mere voiceless computing machine."

But, despite these "grave misgivings," Durfee continued, "the Board for the first time has removed this requirement, in an all out effort to cooperate." He asked the subcommittee to treat the non-public staff memoranda "with the same respect and confidence that our employes deserve and need in their work."

Prior to the hearing, CAB Chairman James R. Durfee wrote Moulder that "All but a small portion of the voluminous files of the Board are either readily available or will be made available," but "there are established legal and policy considerations which require the withholding of the remaining small portion."

CAB's order requiring clearance for the release of communications between the Board and other governmental departments, Durfee said, "does not mean that such documents will not be provided." He added, however, that the Board "does not feel at liberty to divulge materials" relating to overseas and foreign routes.

Durfee also protested the release of memoranda among Board members and among members and their staffs. He said, "Each Board member employs a confidential assistant who occupies a relationship to the member similar to that which exists between the judge and his law clerk. Further, the Board is required by law to take its actions after deliberation and consultation among the members, again in the fashion of a multi-member court."

'Elation' Test Bed Takes Off

Lockheed "Elation" test bed, taking off from Burbank, Calif., showed favorable performance characteristics when flown by an Aviation Week staff member (AW Oct. 14, p. 93). The aircraft a Navy R7V-2 hailed to Lockheed for use in a 1,000 hr. test program, is equipped with four Allison 501-D13 engines and Aeroproducts 606 propellers, the same combination destined for the Lockheed Electra. Test bed was damaged shortly after program started in a landing at Edwards AFB when the left landing gear did not extend because of hydraulic failure. Structural assembly of first Electra has been completed by Lockheed at Burbank and first flight is scheduled for January. It is scheduled for delivery to Lockheed's engineering flight department in December.

CAB Orders Probe Into Legality Of Airlines' Family Fare Plan

Washington Investigation of the economic and legal aspects of airlines' family fare plans which have been in effect since 1948 has been ordered by the Civil Aeronautics Board.

The order was issued to determine whether the reduced family fare plans are discriminatory, preferential, prejudicial or otherwise unlawful.

The proceeding was instituted as a result of the Capital Family Plan Case in which Capital Airlines proposed to extend family plan days to Saturdays. In ruling on the case, the Board found that Capital's proposal is not unjust or unreasonable on the basis of the present record.

However, a decision as to whether or not the plan as a whole is lawful has been deferred until after an industry-wide investigation.

Saturday Plan

Examiner Merritt Ruhlen earlier had recommended that the Board institute a comprehensive investigation to determine the lawfulness of all family fare plans.

Ruhlen also found that Capital's proposal was not unjust or unreasonable but concluded that there was grave doubt as to the lawfulness of the family fare plan on any day of the week.

At present, some airlines have family plan fares in effect from Monday noon through Thursday noon while others have employed it from Tuesday through Thursday.

After CAB's suspension of the Saturday proposal expired last March, Capital, Northwest and Allegheny had extended the family plan to include Saturdays.

Capital's Reason

Capital decided to add Saturday as a family fare plan day for two reasons, according to the CAB:

- **In order to generate** additional revenues to help offset the more than $3 million net loss reported for the 12 months ending Sept. 30, 1956.
- **To aid in the leveling out** of traffic over the days of the week.

The Board said the family fare plan has been successful in generating new traffic and in leveling out traffic over the days of the week.

It added that it was reasonable to assume that this has been accomplished on a profitable basis because the carriers have maintained the family fare plan in effect over a long period of time.

The Board said that, "If it should develop that Capital's Saturday family fare plan has a significant weakening effect on other carriers, we can re-examine the reasonableness of the plan in the light of the actual experience under it in the comprehensive investigation we are undertaking."

Extension of Plan

Vice-Chairman Chan Gurney dissented from the majority in deferring a decision on the lawfulness of Capital's proposal, while Member Harmar Denny dissented with the majority that the proposal falls within the zone of reasonableness.

Both said other competing carriers will be forced to extend their family fare plans to Saturday or suffer a severe loss of Saturday traffic in diversion.

Denny added that the family fare plan was originally introduced where there was no coach service available but that since that time, coach service has been expanded tremendously.

The fares for coach service and the family fare for a family of two are quite comparable in the short haul markets, he said, while fares for coach service are lower in the long-haul markets.

Denny suggested that the carriers continue to develop aggressively the coach market in order to bring air transportation within the reach of a greater portion of the population.

CAB Asked to Suspend Cargo Rate Increases

Washington—Civil Aeronautics Board has been asked to suspend and investigate the proposed tariff increases on special commodities filed by commercial airlines last month.

Requests were made by Air Freight Forwarders Assn. and American Shippers Inc., who asked that an investigation be made to determine whether the charges proposed are in the public interests or, contrary-wise, discriminatory or otherwise unreasonable rate adjustments.

Both the association and American Shippers said they were not opposed to freight rate increases where the increases are not discriminatory and where they can be justified on the basis of costs.

The specific commodity increase filed by the certificated carriers will become effective on Oct. 13 unless suspended by the Board.

The contemplated increases, the association said, are of such far-reaching significance and are so all-inclusive in their coverage that they are bound to have a serious impact upon the shipping public, the revenues of the direct carrier and the revenues of the air freight forwarders.

"The Board should cautiously consider the total effect of a universal change of the kind proposed, and can best do this only after an investigation and hearing at which all necessary evidence would be made available to it."

The proposed increases on special commodities range from about 8.5% for the 100 lb. volume to more than 10% for 10,000 lb. or more.

We might consider the competition of the railroads," American Shippers said "who have been forced into the position where every increase in rates loses freight for them and they have not yet been able to get off the merry-go-round.

"It seems that a fair statement would attribute at least to some extent the constant growth in air cargo to the growing narrowing differential between ground transportation costs and air transportation costs."

American Shippers pointed out that if the present rate schedule is maintained while ground transportation rates are increasing, growth of air transportation alone might provide the increased tonnage and, consequently, the profitability that the air carriers are endeavoring to attain.

The CAB recently approved increases in the general commodity rates ranging between eight and 10%. These are already in effect.

AIRLINE OBSERVER

► Many airline officials fear the logic behind Civil Aeronautics Board decision in the recent suspended passenger fare investigation (AW Oct. 7, p. 38) will act as a strong barrier against any rate increase in the immediate future. In reviewing the investigation, these officials are now conceding that the Board's decision was the only logical conclusion it could reach on the strength of the testimony presented by the trunk carriers. Chief criticism of industry's stand in the case is directed toward airlines failure to be more detailed and explicit in actual financial requirements for the purchase of turbine-powered transports.

► Air Transport Assn. will move into its new quarters next week-end in order to bring the entire organization under one roof for the first time since 1949. ATA is presently housed at four separate locations in the Washington area. New offices will be located at 1000 Connecticut Ave.

► Increasing tenseness in the competitive race for transcontinental nonstop traffic (AW Oct. 14, p. 47) is underscored by protests filed by United and American with the Civil Aeronautics Board against TWA's introduction of Sleeperette seats on its Constellation 1649As. The two complaints have forced the Board into an investigation of the TWA action to determine whether a surcharge should be imposed for the sleeperette service which, the protesting carriers allege, involves a substantial reduction in seating capacity, causing first class airline fares to be unreasonable and discriminatory.

► Qantas Empire Airways pilots have been denied a pay increase as the result of a recent Australian arbitration court decision. About 245 pilots struck last April in attempts to get wage increases of as much as $4,122 annually but returned to work in nine days after agreeing to abide by the court's ruling. The court's decision termed the increase unjustified and may block other Australian pilots from getting pay hikes. Top Qantas pilots now earn $7,742 annually.

► Chicago will defer bond issues to pay for the installation of new runway at O'Hare Field until traffic studies being conducted by Civil Aeronautics Administration's Technical Development Center are completed. The center will determine the best possible location of the proposed runway from the results of tests now being conducted under its air traffic control simulation program. Studies will be completed next month. The center is also analyzing the Los Angeles airport problem and is expected to recommend a site for a second Washington, D. C., airport later this month as a result of traffic studies of that area now under way.

► Civil Aeronautics Administration has postponed the effective date for control of all airspace above 24,000 ft. until Dec. 1. Request for the delay was made by the Air Force and Navy to provide sufficient time for briefing of pilots and distribution of new maps and charts.

► Military emphasis on missiles and resultant decline in manned aircraft will slow down development of the next generation of transport aircraft according to Air Commodore F. Rodwell Banks, director of Bristol Aeroplane Co. Banks says the effect of the change is already being felt in Britain and will soon be felt in the U. S.

► Rolls-Royce will expand its Montreal manufacturing and engine overhaul facilities with an additional 27,000 sq. ft. of floor space. The company also will establish a part turboprop engine overhaul line in addition to existing lines which handle the Nene turbojet and the J34.

► Airline stocks remained static on the New York Stock Exchange early last week during the market price upswing that was led by large block exchanges of missile and aircraft stocks. Railroads, however, rallied sharply with the rest of the market advances sparked by the Russians' successful satellite. Common stocks of all 10 domestic trunkline carriers listed on the exchange held firm within no more than two points of their 1957 lows.

Airline Traffic — August 1957

	Revenue Passengers	Revenue Passenger Miles (000)	Load Factor (%)	U. S. Mail	Express	Freight	Total Revenue Ton-Miles	Per Cent Revenue to Available Ton-Miles
DOMESTIC TRUNK								
American	671,913	472,660	67 4	1,572,390	840,304	7,401,649	55,247,328	58 6
Braniff	172,248	76,937	60 4	249,887	137,875	465 756	8,244,984	48 5
Capital	375,207	141 832	59 2	491 296	257,154	452,775	14,803,053	47 9
Continental	82 386	40,203	58 6	103,091	57 741	155 647	4,173,969	48 0
Delta	233,047	113,983	60 8	323,098	275,370	789, 71	12,343,041	56 6
Eastern	665,825	356 632	61 48	867,071	551,180	1,163,851	36,899,840	53 47
National	113,460	69,643	62 5	24 ,629	49 222	459 146	7,477,403	52 3
Northeast	103,605	29,172	55 2	29,376	26,995	6 ,263	2,911,088	46 2
Northwest	142 807	104,204	66 6	344,747	240,607	877 283	11,471,939	56 7
Trans World	443,636	394,281	71 1	886,343	657,249	2, 64,6:3	41,480,228	61 6
United	613 40	484,843	70 9	2,402,674	930,991	5,273,649	55 180,066	60 2
Western	132,617	69,721	65 7	239,282	105,250	260,040	7,277 100	59 2
INTERNATIONAL								
American	13,523	10,014	63 6	13,942	439	285,480	1,360,801	65 9
Braniff	4,452	9,203	55 9	17,9 0		84 871	1,105,398	50 4
Caribbean-Atlantic	20,708	1 507	57 74	1 427		2 999	162,530	62 28
Delta	6,841	8,194	71 4	7 210		40,644	961,320	61 4
Eastern	33,475	43 536	70 77	63,228		104,168	4,361,078	64 07
National	6,443	4,456	50 5	1 ,187	3,899	34 254	511,598	47 8
Northwest	3,736	29,605	66 9	999,319	23,141	598,854	4 737,968	73 8
Pan American								
Alaska	0,113	11,013	73 5	44,809		284,450	1,455 709	59 7
Atlantic	123,132	164,708	69 3	1,037 403		2,1 5,883	20,308,284	63 4
Latin American	118,505	127 654	70 7	378,635		4,231,868	16,494,271	66 5
Pacific	30,692	1 7,076	82 8	890,663		1,443 163	14,206,098	72 0
Panagra	11,547	14,936	59 6	59,591		431,552	2,082,643	59 0
Trans World	33,533	91,125	65 7	782,140		684,770	10,906 851	63 7
United	13,569	33,683	85 0	111,784		67,667	3,610,301	77 8
LOCAL SERVICE								
Allegheny	46,859	8,273	52 3	8,828	18,841	18,933	836,291	47 7
Bonanza	14,118	2,985	45 6	3,764	2,160	6,261	298,148	43 6
Central	12,647	2,546	39 5	4,324	2,416	9,670	260,211	34 1
Frontier	22,845	5 993	61 3	16,234	7,939	72,186	672,560	72 0
Lake Central	5,789	2,471	38 0	2,912	17,414		256,818	41 3
Mohawk	40 130	7,793	45 9	6,196	17,422	25,715	793,429	46 7
North Central	67,962	11 290	51 0	23,626	39,178		1,145,797	51 0
Ozark	40,567	6,711	44 5	1,975	18,096	20,266	691 467	46 5
Piedmont	40,499	8,652	61 4	14,600	11,489	16,767	871,064	60 7
Southern	20,104	3,721	41 6	9,171	13 057		378,763	41 0
Southwest	35,853	7,268	62 0	9,089	5,000	8,297	717,018	59 8
Trans-Texas	22,203	4,960	40 9	13,569	9,265	27,609	523 633	41 4
West Coast	26,367	4,599	54 95	4,631	2,751	7,206	453,422	51 93
HAWAIIAN								
Hawaiian	43,903	7,054	59 4	3,397		141,179	711,034	55 3
Trans-Pacific	19,869	3 996	64 2	1,328		15,186	320,729	64 0
CARGO LINES								
Aerovias Sud Americana						840,008	840 008	91 8
Flying Tiger	13,273	55,173	99 9	29,050	26,980	7,198,297	12,771,644	83 4
Riddle				25,252	13,323	1,535,772	1,574,347	61 1
Seaboard & Western	10,057	39,200	100			992,149	4,922,131	74 7
Slick	6,852	37,595	100	68,348	67,084	3,655,835	7,550,760	88 95
HELICOPTER								
Chicago Helicopter	7,140	15 2	36 1	2,094 8			13,110	29 2
Los Angeles Airways	3,462	124	62 31	4,055	2 071		17,949	66 75
New York Airways	6,983	130	44 8	2,016†	898	638	16,056	45 7
ALASKA								
Alaska Airlines	599	863	22 6	16,557		187,412	297,193	38 7
Alaska Coastal	7,638	647	65 8	7,492		5,319	78,547	69 7
Cordova	2,295	558	54 3	4,564		180,545	241,562	53 0
Ellis	7,986	454	57 0	2,265		4,284	52,505	66 6
Pacific Northern	15,085	15,868	66 7	01,963		305,464	2,123,081	70 1

*Not available; †Mail transferred in bulk
Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

SHORTLINES

▶ **Trans-Canada Airlines** will begin twice weekly nonstop service from Toronto to Glasgow and London on Nov. 16 using Lockheed Super Constellations. The flights are in addition to two other weekly services from Toronto to London with a stop at Montreal

▶ **Airlines Clearing House** reports airline business transactions were up 14.26% in August. Total interlines business transacted in August was $65,535,595 93 as compared with $57,359,027.90 in August, 1956

▶ **Mohawk Airlines** set a company record last month by carrying 38,357 revenue passengers and flying 7,172,759 revenue passenger-miles for increases of 18.2% and 27 2% respectively over September, 1956. This gave Mohawk a total of 311,928 passengers for the first nine months of the year, 21.7% over the same period last year. The airlines also carried 61,909 lb of air mail, 153,813 lb. of express and 232,019 lb of freight in September.

▶ **Riddle Airlines** carried 5,344,566 lb. of cargo in September, a 20% increase over August and a 29% increase over September, 1956.

▶ **Southern Airways** flew 18,887 revenue passengers 3,042,174 revenue passenger-miles during September for a passenger load factor of 45 26%.

▶ **Bonanza Air Lines** reports it carried a total of 134,180 revenue passengers during the 12 months ending June 30 The airline says, with the exception of January and February, the system carried a record number of passengers during each month of the year, exceeding the previous month in 1956.

▶ **Atlanta Airport** and Delta Airlines, Capital Airlines and Southern Airways have dedicated a $400,000 passenger concourse constructed by the airlines. The facility will be used until Atlanta's new $8 million terminal is completed in 1960. The 1,250 ft. long concourse will provide 17 aircraft parking positions with 11 for Delta, four for Capital and two for Southern.

▶ **Northwest Airlines** will open a city sales and ticket office in Madison, Wisc., late this month. The office will be located in the Park Hotel in downtown Madison. Northwest boarded 21,826 passengers in Madison during 1956, an increase of 22 5% over 1955, and says it expects a significant gain in boardings this year

COCKPIT VIEWPOINT

By Capt. R. C. Robson

. . . And One for Good Measure

Early in its life aviation learned of the many benefits gained from duplication of equipment. Powerplants went from one to two to four. Aircraft systems, electric, radio, hydraulic, instrument, fuel, etc.—even the pilots—have come in for the dual or better treatment in all but our smallest ships

Despite the extra added cost of these things, and consequently a great deal of initial resistance, it is doubtful in this day and age if any operator would advocate a return to single systems People have learned that these extras are not luxurious frills but good insurance on their investment

Another Second Feature

Any device must necessarily prove itself over a period of years. It gradually becomes accepted as standard fare. Then when new aircraft are ordered the device comes built in, generally in duplicate. As you may have suspected my purpose here is to begin to sell the idea of another second feature

The new air transports, the turbines, will incorporate many innovations. They will also have certain needs which must be satisfied. One of these requirements, operationally if not legally, will be a properly functioning automatic pilot. Most likely all new jets will have this connected to the latest computors which permit coupling to navigation aids, radio or instrument, as well as the usual flight control system.

The operational requirement for an autopilot is, of course, dictated by the need for flight path precision. Any wandering or hunting can impose severe economic penalties through very small reductions in performance To put it another way, the autopilot will pay for itself many times over in savings in fuel and time -in actual dollars and cents (see p. 85)

This is not the case if the autopilot is inoperative, which, assuming Utopia is still a few years hence, is bound to occur with normal regularity. This could mean inability to dispatch the aircraft. At best it would mean uneconomical flight to the next repair station. At worst, and this is what appeals to me in the cockpit, is an inflight failure—especially at a critical point. I assume that the autopilot will be "on" not only during climb, cruise and descent, but also during most of the instrument approach. The latter is no place to experience a quick disconnect and have the bottom drop out At this point I should be much obliged if a standby unit would automatically take over and continue uninterrupted flight

Big Request

At first glance the installation of a second autopilot may sound like asking for the moon But it really isn't. Turbine aircraft will come equipped with the major part of the second unit. The black intelligence boxes needed to serve the autopilot will in any event also be installed as a requirement for the flight instruments. Hence one need only attach these additional units to servos and provide suitable relays to have completely dual autopilot operations

The value of an autopilot in our new aircraft can hardly be over emphasized. The navigation and communication burden at these higher speeds will, more than ever, prevent pilots from giving optimum attention to the flight control manipulation. Manual flying is simply going to require slowing down if one is to accomplish the required cockpit chores in the allotted span. So even disregarding the added safety of duplication, a second autopilot will bring rich financial rewards to multi-million dollar aircraft operating at several thousand dollars per hour. If I may hazard a guess at this point I would say that a stand-by autopilot will eventually be a definite requirement for airline operations

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a swept-wing "economy size" jet
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Designed for a variety of Jet Age military missions, the Lockheed JETSTAR is a 4-engine utility jet transport that flies 500/550 mph, at altitudes of 25-to-45,000 feet, 2,000 statute miles and more.

Amazingly quiet (due to the aft fuselage mounting of engine jet pods), the new JETSTAR is an ideal aircraft for economical: *bomber pilot transition • in-flight refueling indoctrination • bombardier training • ECM training • high-altitude photographing • airways systems inspection • high priority cargo/passenger transportation • tow-target aircraft • navigator training.*

Like all Lockheed planes, the new JETSTAR is easy to maintain and economical to operate. And it has the inherent stamina to insure optimum utilization and long life—qualities that are more important in military aircraft today than ever before.

LOCKHEED — *means leadership*

Lockheed Aircraft Corporation
Georgia Division, Marietta, Ga.

First flight of the JETSTAR (powered by two Bristol Orpheus engines with a total takeoff thrust of 10,000 pounds) was made September 4, at Edwards AFB. A second prototype, scheduled for flight early in 1958, will be powered by four General Electric J-85 or Fairchild J-83 engines.

AVRO CF-105 Arrow, Canada's newest two-place, twin-engine, long-range interceptor, is shown during rollout

SECOND flight-test CF-105 is in its mating jig. Jig is part of production tooling used in manufacture of all CF-105s.

CF-105 Displays Advanced Engineering In Rollout

By J. S. Butz, Jr.

Toronto—Avro CF-105 Arrow has given Canada a serious contender for the top military aircraft of the next several years. The large, decidedly advanced delta-wing fighter was rolled out of the Malton plant a few days ago and flight tests are scheduled to begin before the end of December.

The Arrow's power, weight and general design leave little doubt of its performance potential. Important features of the present version of the CF-105 include:

- **Thrust** of approximately 60,000 lb. with Orenda Iroquois engines and afterburning.
- **Maximum** takeoff weight of about 60,000 lb.
- **Area-ruled** fuselage.
- **Very thin** wing with conical cambered leading edges and blunt trailing edges.

Designed for Altitude

The Arrow was designed specifically as a long-range interceptor which would set new standards for combat ceiling and maneuverability at altitude. The aircraft's chances of meeting these specifications and becoming a truly outstanding fighter are intimately related to its powerplant.

Primary requirement for pushing effective high altitude operation higher is an outstanding thrust-to-weight ratio for both aircraft and engine. (Engine thrust rather than wing lift is the main support of today's fighters at very high altitudes. Thrust holds them in turns and other maneuvers without loss of altitude.) If the engine thrust-to-weight ratio is an improvement over existing types, the aircraft can usually be built to show a similar improvement. The main burden on the aircraft is that it must remain stable and flyable at the new altitudes and speed that the improved thrust-weight ratio will allow it to reach.

Both the CF-105 and its Orenda Iroquois powerplants are approximately four years old and each is about to begin flight test after extensive test programs in facilities in the U.S. as well as Canada. As a precautionary measure their flight testing will be accomplished separately rather than as a unit. The Arrow will use J75 engines during its first test phases and the Iroquois will be flown in a B-47 test bed.

Iroquois Saves Weight

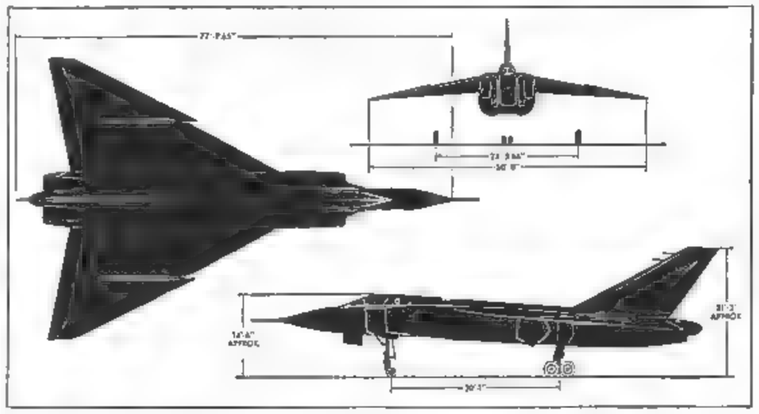
The Iroquois has had extensive ground running under sea level and altitude conditions and has been licensed for production in the U.S. by Curtiss-Wright. The engine uses the most modern design practice in saving weight and it produces around 23,000 lb. of thrust for 4,500 lb. of engine weight.

Afterburning thrust is in the neighborhood of 30,000 lb.

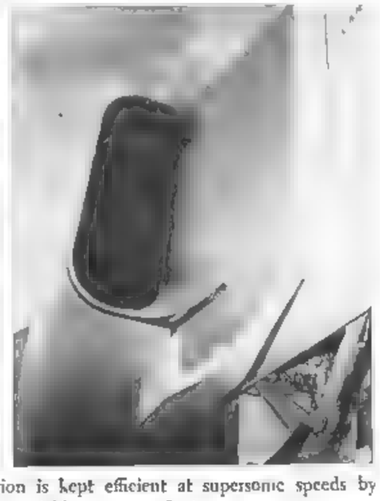
The very high thrust-to-weight ratios of the aircraft and the engine which will aid high altitude, high speed maneuverability will also give the Arrow impressive performance in other areas. Its maximum speed should be well over Mach 2 if comparisons with existing fighters can be used as an indication. Since aerodynamic heating problems begin between Mach 2 and 3, the Arrow's top speed will probably be limited by structural heating rather than by a lack of power.

The rate of climb of the CF-105 should be tremendous at all weights. Even at maximum takeoff weight the Arrow has a thrust-to-weight ratio of about one, which is greater than any existing aircraft except a VTOL.

As far as ceiling is concerned, Fred



ARROW is a large aircraft. For comparison, B-58 has 55-ft. span and is 95 ft. long. F-102A is 68 ft. long with a 38-ft. wingspan.



ARROW'S engine air inlets have fixed ramps and wide boundary layer bleeds. Duct operation is kept efficient at supersonic speeds by bleeding air through perforations on ramps (right photo). This is an alternate solution to the variable geometry duct.

LOWER rear portion of inlet ramps (above) are dumps for some of duct bleed air.

T. Smye, president of Avro, has stated that the Arrow will be able to intercept and destroy aircraft flying at 75,000 ft. There was no explanation as to whether the Arrow would reach this altitude in a zoom climb, or whether the Arrow actually had to reach 75,000 ft for its missile armament to destroy the hostile aircraft, but it does give some indication of the Arrow's altitude capability.

In the design of the Arrow, the Canadians state that they have tried to make the best possible use of their association with two foreign aircraft industries. They maintain intimate contact with British and American work, especially with projects that are similar to their own. For instance, delta-wing flight test and experimental work at Convair and in England have aided Avro materially.

J. C. Floyd, Avro vice president, engineering, who has technical responsibility for the Arrow, is strong in his appreciation and praise for the kind of assistance Avro has received from NACA, the Air Force and the Navy as well as some U.S. companies. Other Avro officers and Canadian government officials took the opportunity of the Arrow unveiling to make similar acknowledgements of U.S. help and cooperation

However, the exchange of information is anything but one-sided. Some of the most important Canadian contributions so far have been in metallurgy and aircraft and engine structural design and fabrication techniques.

Aerodynamic Testing

Aerodynamic development of the Arrow design began about four years ago. Wind tunnel tests have been conducted at the National Aeronautical Establishment in Ottawa, in NACA tunnels at Langley Field and Cleveland and at the Cornell Aeronautical Laboratory. Thirteen free-flight rocket models have been fired to supplement the wind tunnel data which went to Mach 2. Eleven of the rocket models were launched over Lake Ontario and the other two in Virginia. All attempted launchings were successful, a small record

The wing planform resulting from all of this experimentation is a sharply swept delta shape with the trailing edges also slightly swept. Blunt trailing edges make the wide chord control surfaces along the trailing edge more effective and reduce wing drag slightly at very high speed.

Leading edge extensions are used on the outer half of the semi-span. These extensions, as well as the leading edge of the inboard wing sections, have conical camber to help improve lift distribution and induced drag. Flow conditions at the wing tips, which are

WIDE CUT in the wing leading edge just inboard of the leading edge extension creates an aerodynamic fence. Air moving into the cut is forced straight back over the wing, restricting spanwise flow over the outboard wing sections. Long landing gear on the CF-105 was designed and built by Dowty, a pioneer company in the use of very high tensile strength (around 250,000 psi.) in production gear. High precision forging techniques and new production machining methods had to be developed to use the high strength materials.

ARROW has unusual afterbody fairing between afterburner exits to cut base drag. Fairing and some of the after portions of the engines are covered with high temperature materials and not painted. Fairing would be ideal location for auxiliary rocket engine for climb and acceleration, but Avro officials say that performance in these areas is so great that this would probably never be considered.

LARGE WEAPON BAY on the Arrow begins just under the RCAF roundel and runs aft to the landing gear door. The complete bay is removable to cut rearming time to a minimum. The bay carries air-to-air missiles with internal guidance.

normally somewhat unstable on a delta wing, are improved by the leading edge extensions.

They give the outboard wing section a smaller thickness ratio.

A sort of aerodynamic wing fence is also used to improve tip conditions by alleviating the strong spanwise flow on a wing like the Arrow's. A wide notch has been cut in the wing leading edge just inboard of the leading edge extension. This notch ends in a low wide ramp which extends back over the wing. The ramp is raised an inch or so above the wing well back on the chord. The air which passes into this notch and up on the ramp moves straight back over the wing. It combines with the spanwise flow and gives the flow over the outboard wing section a new direction.

Area Rule Discernible

The Arrow is area-ruled, although it is not as readily discernible as it is on some aircraft. Avro worked closely with NACA at Langley Field on the area distribution for the Arrow. It has evidently been achieved with a minimum structural penalty as the fuselage has relatively straight sides without a pinched waist.

Engine air inlets on the CF 105 appear to have fixed geometry which is somewhat unusual for an aircraft with a top speed of Mach 2 or better. Each inlet is approximately rectangular-shaped and perpendicular to the free stream air. Large, apparently fixed, ramps are located ahead of each inlet. There is a wide gap between each ramp and the fuselage which serves as a boundary layer bleed.

At supersonic speed, the ramp creates a strong oblique shock wave in front of the inlet which slows the air entering the duct and raises its pressure. This oblique shock would strike the outside lip of the inlet for best balance of pressure recovery and duct drag. If the angle of the oblique shock is not great enough, and it stands out in front of the inlet, air spills out around the duct lips and creates a heavy drag.

Shock Angle

The angle of the oblique shock varies with Mach number and the position of the ramp. If the ramp is fixed, the shock angle will be correct at only one Mach number. Many supersonic aircraft have variable position ramps or some kind of variable geometry so that their inlets may operate at maximum efficiency over a wide speed range. The penalty of variable geometry is added weight and the necessity of having a sensitive servo system to match duct geometry with Mach number so that the oblique shock will be properly located at all supersonic speeds.

The Avro approach apparently seems to reject the weight and complexity of variable ramps. Instead its fixed ramp has a wide band of perforations just ahead of the inlet. There is a bleed duct behind the perforations leading farther back on the aircraft. This duct provides an alternate path for the air so that when the oblique shock is not

positioned properly the air does not spill around the lip. The air is carried aboard the aircraft and taken aft through the duct to a negative pressure area and dumped.

This type of inlet probably is not as efficient as one with variable geometry but if the aircraft spends a large part of its supersonic time in one fairly wide Mach number range, the weight savings of the fixed ramp would be very desirable. The Iroquois engine has been designed for maximum efficiency in supersonic flight at some expense in subsonic performance (AW July 29, p. 26).

Canopy Drag Reduction

Another interesting feature of the aircraft is what appears to be a large exhaust opening just after the crew's tandem compartment

The bulge of the crew's canopy fairs back to a rather large spine which runs back to the vertical tail. The spine helps reduce the drag of the canopy as well as serving as a conduit for wires, controls, etc. The large exhaust port is on the back of the canopy just above the spine. Air exhausting here from the air conditioning or some other internal system would further tend to reduce the canopy drag by lowering its base pressure

Armament on the CF-105 is presently intended to be all guided missile.

The Sparrow II is planned for production in Canada but the exact status of this program is cloudy at present. The Arrow's missiles are carried internally in a very large removable container. The length and width of the container is such that it would just fit into a B-29 bomb bay although it is not as deep

The electronic system for the Arrow is a specially designed unit which combines automatic flight, weapon fire control, communication and navigation functions. The system is named Astra I and RCA in the U. S. is the prime contractor

Guidance of the Arrow and its armament is divided into three phases.

- **Full ground control** toward general area of target
- **Mid-course phase** when aircraft search radar is also in operation.
- **Terminal phase** when the aircraft radar is locked on the target and the missile is launched

The whole operation may be monitored by ground control and, if any part of the aircraft's system goes out, ground control can take over, although its accuracy is below that of the airborne unit because of its great distance from the combat area

Avro is tooled up for production of the Arrow. The first aircraft which was just rolled out was constructed on this tooling. At least five more fuselages

were visible in the factory during the unveiling of this first aircraft.

Construction of the Arrow is characterized by a large quantity of metal-to-metal bonding to reduce the weight and labor involved in riveting, and some other methods of joining metal. Magnesium as well as aluminum is bonded in quantity on the Avro Arrow, and the Canadian Government decided to have a formal roll-out of the first Arrow and let everyone get a good look at the airplane so that they could go about preparing for the first flight in peace. Security regulations had forced Avro to do much of this type of work on the CF-100 behind screens and at night to keep anyone passing down the public highways near the plant from photographing the plane.

The decision to forego the security inconvenience was deemed a wise one but the timing of the rollout was quite unfortunate. It happened to occur on the same date that the Russians launched their first satellite. The Arrow was pushed from its place in the news, even in Canada

NAA to Develop Hi-Temp Power Generator System

New airborne power-generator system, capable of withstanding prolonged temperatures of 600 deg. F, will be developed by North American Aviation under Air Force contract which calls for a four year program.

John Maxian, Jr., chief electrical engineer, will direct the program, with John Pierro as electrical project engineer. Program is not aimed at any specific plane but is designed for the benefit of the Air Force and the industry.

Work will be performed at the Los Angeles division and will be monitored by the Aeronautical Accessories Laboratory of the Air Research and Development Command's Wright Air Development Center. NAA will be responsible for managing the development and integration of the system into finished form, with much of the detail work being done by subcontractors under its supervision.

Boeing Jet-Thrust Plant Ready for Shakedown Test

Boeing Airplane Co. will begin initial shakedown testing of its new $300,000 sound suppressor-thrust reverser test facility at Renton, Wash., this week Facility consists of two engine ground run-up silencers or tube-like steel chambers measuring 45 ft. long by 12 ft. diameter. First tests will be in the nature of an instrumentation and facility shakedown prior to commencing testing on the actual suppressor-reverser units developed by Boeing for installation on its 707 commercial jetliners.

Use of High Temperature Materials In Aircraft Discussed at SAE Meet

Los Angeles—Some engineering problems in the application of high temperature materials to aircraft construction were outlined at the Society of Automotive Engineers National Aeronautic Meeting here by J. W. Price, Production Design Engineer, Douglas Aircraft, Long Beach plant.

While the key point in selection of structural materials is the strength-weight ratio in the appropriate temperature range, load carrying ability is largely dependent on configuration of piece. Producibility therefore has an important bearing on the value of structural material.

Metal may be strong, light and economical but if it can't be fabricated or assembled into a shape that will carry the required loads, it is of no use.

Most of an airframe is subject to compression loads. Thin skins must be supported to prevent buckling. Sandwich construction and corrugation stiffening offer optimum configurations, but no satisfactory means has been found for fabricating double-contoured surfaces. This indicates dependence of load-carrying ability on manufacturing skill and techniques.

Close Tolerances

Most of the high-temperature material in airframe is sheet. Obtaining close thickness tolerances is a must if bad weight penalties are to be avoided. Standard aluminum sheet tolerances are ±5%. Design thickness must be 5% above minimum tolerance to insure adequate strength. Titanium and stainless are fabricated to tolerances of 10%, meaning that design thickness must be 10% above minimum tolerance. Effect on an airplane the size of the B-52 is to add 5,000 lb., not counting growth factor effect on weight of fuel, engine and supporting structure needed to carry the heavier skin.

Also critical is the weight increase caused by extra joints. High temperature materials must be made in larger sheets to minimize this problem. On a B-52 size airframe, the number of wing sheets could be reduced from 200 to 80 if sheet sizes were increased from 120 in. x 36 in. to 240 in. x 48 in. If the 240-in. sheet is used as zero base, weight penalty for using 120-in. sheets is about 4,000 lb. and for using 96-in. sheets is about 6,500 lb.—again discounting growth factor.

Other factors affecting selection of high temperature material are:

- **Availability**—many companies refuse to consider a material unless it is available in quantity when a design is being formulated. Others keep a forecast availability curve over five, 10 or 15 year periods, choosing materials expected to be ready at the start of fabrication.
- **Dependability**—sometimes 50 or 60% of an order of skin stock has been scrapped because of gall marks, blisters, non-uniform heat treat and varying thickness. This is not dependability.
- **Cost**—present keen competition in aviation has made this more important than ever. It must include not only the price of the material but manufacturing cost. Hard materials require at least a 400% increase in tools, power and labor to remove the same volume of material as from a soft material. A machine for cutting stainless may cost four times as much as one for aluminum and be four times slower. Cost is increased by a factor of 16.
- **Producibility**—characteristics that give strength at elevated temperatures also make a material difficult to fabricate.

Energy Sources

Characteristics and some design criteria for missile auxiliary power units were described by Paul C. Ricks of AiResearch. Energy for guidance and control of early missiles was usually supplied by hydraulic-pneumatic accumulators where fluid power was required and by batteries where electrical power was needed. These were objectionable from standpoints of weight and sensitivity to changes in environment.

Dynamic, rather than static, battery and accumulator sources cut weight, and use of a propellant gas turbine as an auxiliary system prime mover offers power that is practically independent of environment.

Few rule-of-thumb selection criteria can be extracted from experience because auxiliary power is such an integral part of the missile that it must usually be tailor-made. But Ricks noted some patterns in the matching of a missile and auxiliary power unit:

- **Complex**, high-efficiency turbines can be used in units of high power and long operating time despite greater weight, because fuel makes up a larger proportion of total weight and fuel savings due to efficiency more than offset installed unit weight.
- **Simple** turbine of yet greater weight will sometimes be chosen despite less efficiency because of cost, ease of servicing, etc.
- **Liquid** monopropellant turbines are usually selected for units requiring a duration of over 60 sec. They offer packaging flexibility and controllability but have high dead weight.
- **Solid** propellant is better for short duration with small power variation.
- **In smaller** power sources, the power unit must be completely integrated by a single supplier to keep the auxiliary power system from being too large a part of total weight.

Prime mover components are usually selected after load components have been tentatively selected. Turbine diameter and shaft speed are determined by compromise with performance, structural limitations and reliability. Performance of the turbine is about proportional to its peripheral velocity but must be limited by structural considerations to 1,000 to 1,200 ft. per sec.

Propellant gas turbines used as missile auxiliary power units ordinarily have low power output (one to 70 shp.) and very high available heads (up to 700,000 ft.-lb./lb.), producing low specific speeds and efficiencies.

Performance Goals

Some performance goals for missile auxiliary power units were mentioned by R. D. Boyne of General Electric, Aircraft Accessory Turbine Department:

- **Specific** fuel consumptions should be lowered to 6-7 lb./bhp.-hr. In current liquid monopropellant units, specific fuel consumption is about 10-12 lb./bhp.-hr. In solid propellant units it is higher, especially where load varies. Some progress has been reported using hydrazine but there is still much to be done.
- **Turbine** efficiency of 50% using monopropellants is being sought by the industry and will help improve specific fuel consumption. Efficiency must be balanced against manufacturing costs. High nozzle velocities [illegible] turbine [illegible] increase efficiency. Weight and burst protection balanced against efficiency indicate that 1,600-1,700 ft./sec. is a reasonable goal. Yet to be fully explored is the reciprocating internal decomposition engine.

Vertol on Oil Rig

Vertol 44 helicopter lands on 54- by 64-ft. platform by oil rig in the Gulf of Mexico. Helicopter flew from Cameron, La. to the Continental Oil Co. offshore rig during a demonstration tour the company is conducting to show the ship's capabilities to the petroleum industry. Tour marks the beginning of Vertol's first major commercial sales campaign.

Westinghouse All-Weather System Guides

In any weather, day or night, USAF's BOMARC, operating at supersonic speeds and extreme altitudes, is guided to the target by its Westinghouse ground control and target seeker systems.

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Deadly BOMARC

YOU CAN BE SURE...IF IT'S

Westinghouse

IM-99 BOMARC, long range, interceptor missile, designed and built by Boeing Airplane Company.

which shows promise of bringing monopropellant specific fuel consumption down to 5 lb./bhp-hr. Valving, development financing and production cost are problems facing the reciprocating, monopropellant prime mover.

Bovne also discussed the problem of financing these and other developments. If accessory unit performance is to match that of the main engine, it must have a longer lead time, he said. While having all the problems and limitations of any other powerplant, the auxiliary power unit does not receive the early consideration given to the main engine. Missile program schedules are usually tight by the time the accessory maker is called in. Earlier attention from the prime contractor and procuring agency allow more parameter trades between auxiliary power unit and system load.

Bovne suggested that a single military agency be set up to father missile auxiliary power unit technology. A military agency administering a Phase I contract could profitably review with manufacturers the feasibility versus time scale of the necessary power system.

New System Improves Shock Wave Pictures

A multiple-source schlieren system that permits photographs to be taken in sharp focus on any pre-determined plane has been developed by Task Corp., Anaheim, Calif.

First application of the system, which possesses maximum light transmission and a minimum of optical elements, according to F. E. Ward, Task president, will be on blowdown tunnels installed by Chicago Bridge and Iron Co. for Chance Vought Aircraft Co. and Convair.

Primary feature claimed by Task for its system is sharp focusing ability which permits observation of density gradients in a single plane perpendicular to the axis of light. Shock waves and turbulence phenomena can be observed at independent spanwise locations on a model. In the more usual single-source schlieren system, striations observed on the viewing plate represent an integration of all striae in the light train, including irrelevant heat waves outside the test section and scratches in the surfaces of the optical elements.

Use of an external source plate for both transonic and supersonic operations provides the new system with several advantages, Task said. The entire optical system is isolated from the tunnel, eliminating serious vibration problems. Optical sensitivity is solely a function of the source plate line width, and spacing and designing for observation of a six-second light deviation in the tunnel is simplified.

Hypersonic Tunnels Yield Practical Data

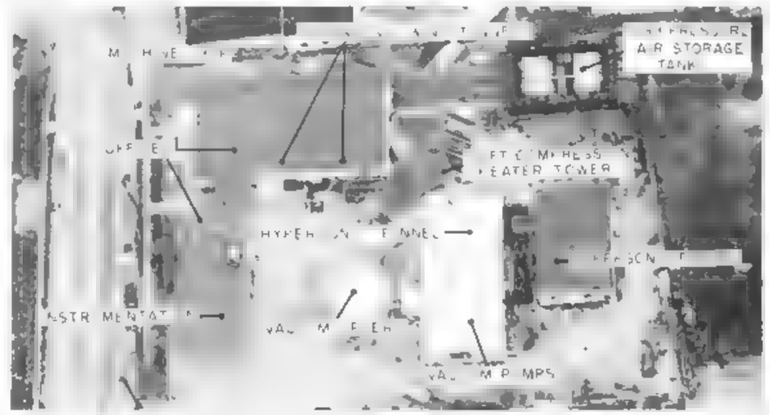
By Robert H. Cushman

Freeport, N. Y.—Hypersonic wind tunnels will become as useful as shock tunnels for the practical solution of hypersonic vehicle problems, according to researchers at the Polytechnic Institute of Brooklyn's Aerodynamics Laboratory.

Recent disclosures resulting from shock tunnel testing show that many of the real gas effects once thought to dictate the exclusive use of shock tunnels for hypersonic flight research can be neglected and that hypersonic wind tunnels with their longer durations and simpler instrumentation can furnish a major part of the needed design information.

The hypersonic wind tunnel now in full Mach 6 operation at Brooklyn Polytechnic exemplifies the faith in hypersonic wind tunnel testing held by the Laboratory's director, Dr. Antonio Ferri.

It is presently being used on investigations of the Convair Atlas ICBM nose, body and skirt through a research contract which Brooklyn Polytechnic holds with the Ballistic Missile Division of USAF's or ARDC.

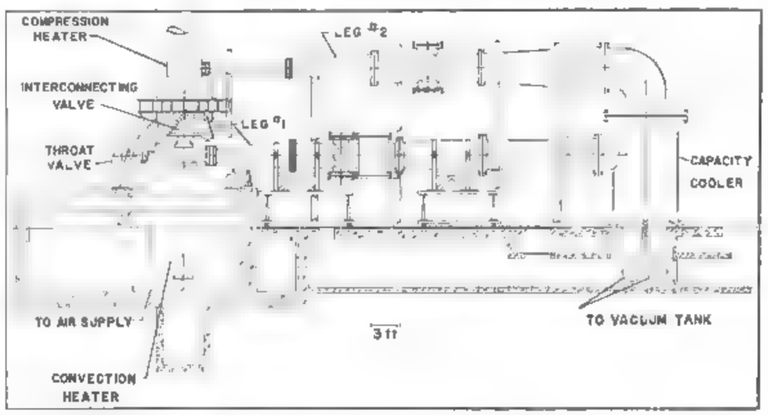


AIR from tanks, upper right, feeds the hypersonic and three supersonic wind tunnels while vacuum sphere receives hypersonic flow. Third tunnel, lower right, is Grumman's.

Model for Others

The Brooklyn Polytechnic hypersonic tunnel is also being used as a model for new hypersonic test facilities at other important advanced research centers. NACA Langley's projected 100 lb./sec. (against 12 lb./sec. for Brooklyn's, versus test 56 million-) duplicate tunnel to be built at USN's David Taylor Model Basin, Washington, D. C.; a large 56 million tunnel in construction at the Naval Ordnance Laboratory, Silver Springs, Md., and the heater portion of the tunnel which is being used by Cornell Aeronautical Laboratory, Buffalo, N. Y., for a special "Gatling gun" shock tunnel under construction.

The significance of the hypersonic tunnel in comparison with the shock tunnel is that the hypersonic tunnel provides the potential capability of reproducing the time-history of a portion of a hypersonic flight, such as an ICBM re-entry. Though shock tunnels can provide scientific information about the real gas phenomena—effects of molecular dissociation and ionization—during their microsecond run durations, a Ferri-type hypersonic wind tunnel can provide practical design information about how a nose cone will react under the combined thermal and aerodynamic loading during the re-entry time, which may last up to a sizable fraction of a minute. It remains to be seen whether the Gatling gun arrangement by which Cornell hopes to feed continuous shocks into a test chamber over a 15 sec. period will equal the realism of a nose cone test performed in a hypersonic tunnel.



AIR entering hypersonic tunnel, left, is either heated in the convection heater and admitted into leg #1, or further heated in tower heater and admitted into leg #2.

Ferri accomplishes hypersonic tests in two steps. First a conventional hypersonic wind tunnel run is made for the aerodynamicist to determine the pressure and force distributions. Because Brooklyn has a large airflow preheating capacity, these tests would be at nearly full flight temperatures though still short of shock tunnel temperature levels.

Hypersonic Technique

Then, knowing the pressure conditions around the nose of the missile a special shroud will be constructed and placed in front of a larger sized model so that the flow would be channeled to reproduce actual flight boundary layer and Reynolds number conditions which influence aerodynamic heating. Brooklyn's tunnel can presently handle up to 9 in. diameter models by this technique.

During the second, shrouded, run which is for the structural designer, the plastic flow of the nose cone surface material or the action of any cooling methods can be observed.

Fight for Funds

Behind this present recognition for Brooklyn's hypersonic work was a long—in the light of the current urgency for such facilities—struggle for adequate funds. Dr. Roscoe H. Mills of the Fluid Dynamics Branch of the Aerodynamics Research Laboratory, Wright Air Development Center, is credited with convincing the Pentagon of the worth of Ferri's concept. At that time, 1950-1951, according to Capt. Charles A. Scolatti, who works for Dr. Mills,

SPECIAL contoured shroud is used to produce realistic boundary layer conditions over use of model for heat transfer studies.

...was possible of heating the tunnel air flow sufficiently to overcome liquefaction as the air was suddenly refrigerated in the expansion to hypersonic flow in the nozzle

Further, the use of conventional two-dimensional tunnel cross sections with their narrow throat nozzle throats sometimes only a hair's height for a couple of inches crossways dimension, made it impossible to prevent throat shape distortion with the high temperatures necessary to combat liquefaction

Ferri's intention to use a circular cross section was discounted because most of the experts were convinced, that disturbances emanating from the nozzle walls would center themselves in a pointed cone upon the model in the test section

Some said that the money would be better spent entirely upon shock tunnels

It was felt that even if the preheating necessary to avoid liquefaction were possible, it would be unlikely that the additional pre-heating to fully simulate flight conditions could be accomplished

According to Scolatti, much of the early financing of Brooklyn's hypersonic facility, worth about $500,000 in replacement value, was by "fall out" funds which were released by the default of their commercial contracts. Much of the research and development and design work which usually greatly increases the cost of this type of facility came from hours of overtime and homework by the Aerodynamics Laboratory staff, Scolatti said. It has been estimated that the facility would have cost two or three times more had it been built by a commercial organization

Description of Tunnel

Brooklyn's hypersonic wind tunnel is of the blow down type. A group of 100 bottles charged by commercial compressors with up to 40,000 lb. of air supply runs up to two minutes useful flow duration. The 2,200 psi. air from the bottles is piped to the large air heaters which pre-heat it so there won't ...test ... thicknesses

The Mach 6 leg number one nozzle now in use expands to a 1 ft. diameter test section and has been used to test ... nose models

Mach 8 Nozzle

Now under construction is a Mach 8 nozzle which will expand out to a 24 in. diameter test section. This nozzle will be of stainless steel and is expected ... for materials. Future plans call for a Mach 14 nozzle which will expand to a 48 in. diameter test section. The Mach 14 nozzle will fully exploit the tunnel's present preheating capacity. Flow temperature in this section would be refrigerated to —400F during the nozzle expansion if the nozzle wasn't preheated

When the shroud technique is used in conjunction with the present equipment, full flight Reynolds numbers and to a large extent the heat transfer conditions which would occur up to Mach 20 can be simulated.

Downstream of the nozzle and test section combination is an air cooler and the large 25,000 cu. ft., 35 ft. dia., vacuum tank to suck flow from the test section

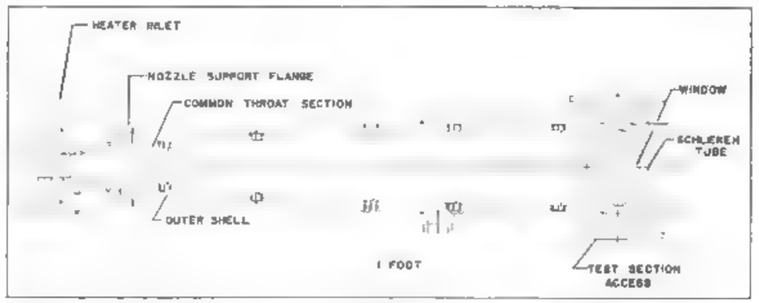
Many of the other details of the facility and the types of tests performed were described in a recent talk by Ferri before the AGARD meeting on model ... by 3,500F electrical resistance rods for full simulation of Mach 6.0 environment in leg number one of the tunnel. ... Ferri expects that this heater can be forced up to 3,000F, though under these conditions ... with ... of ... ceramics

The other higher temperature heater, the compression tower which rises 75 ft. above the hypersonic tunnel, has been delayed somewhat by the recent government fund cutbacks. When completed, it will provide inlet temperatures to the nozzle up to 3,000F. ... This ... preheated air ... the ... heater at the bottom of the tower and then using cold compressed air to ram a 3 ft. wide diaphragm down its 71-ft. length to heat the primary charge by compression as it is forced into leg number two of the tunnel

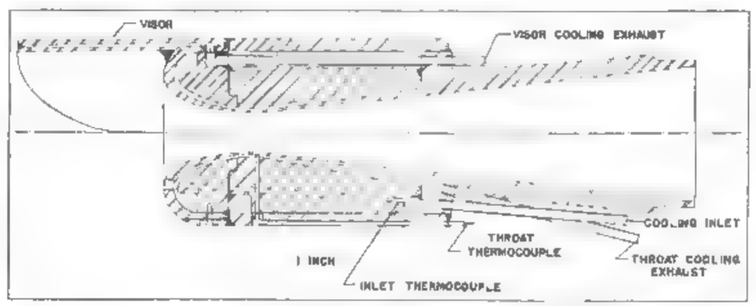
School Makes Nozzle

The nozzles, which are fully contoured, are being made on a $35,000 contour lathe and internal grinding machine recently acquired for this purpose by the school

Brooklyn designs its own nozzles. However, this is complicated by the fact that the boundary layer in this type ...



BROOKLYN builds its own nozzles out of stainless steel sections. This Mach 8 nozzle expands to a 24 in. dia. test section. It will cost $25,000.



CLOSE-UP of nozzle throat shows the vortex visor and passages for the air-water mist coolant to protect the nozzle wall from the up-to-5,000F entering flow

testing at Sets ... Nationals

Besides the hypersonic tunnel, the ... Aeronautics Laboratory hosts three supersonic tunnels all of which ... blow down types working off the same air supplies as the hypersonic tunnel

Two of the tunnels belong to Brooklyn, and the other is operated for Grumman Aircraft Engineering Corp. The ... tunnels under the direction of Dr. Marvin Vidal can take test ... blocks with test sections ranging from 10 in. by 10 in. for Mach 3.0 flows to 12 in. by 18 in. for Mach 5.0 flows. The 600 psi. settling chamber pressures allow these tunnels to simulate modern aircraft flying at up to Mach 3.0 as low as 50,000 ft. altitude.

Grumman Tunnel

The Grumman tunnel has an 18 in. square settling chamber and is presently equipped with a Mach 2 nozzle block which expands to a 12 in. x 12 in. test chamber. Grumman's testing cost at Brooklyn is said to be significantly less ... the cost per hour charged at some other facilities.

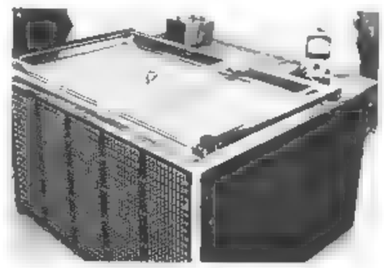
The supersonic tunnels are being ... for ... research projects ...

- **Reducing drag** on external stores as ... is done by recovering the ... shocks with shroud rings
- **Controlling** the shock position of ... shock in stator supersonic compressors for turbojet engines by using air jets
- **Behavior of mixtures** of subsonic and supersonic flow as would be found around inlets, ejectors or boundary layer ... cooling slots

PRODUCTION BRIEFING

Consolidated Diesel Electric Corp., Stamford, Conn., will build fuel control ... test stands for Hamilton Standard Div., United Aircraft Corp. ... tests will have ... to ... flow with pressures up ... psi.

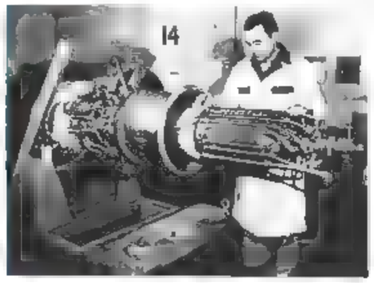
Nuclear reactor ... flow problems ... solved by electronic ... computer designed by Nuclear Development Corp. of America under contract ... Pratt & Whitney Aircraft ... and ..., ... containing the ...



trolyte is 3 ft. by 5 ft. by 3 m. deep. Readings are taken by means of 1,500 electrodes. In order that these may be arranged in configurations that will fit a model cross-section duplicating the shape of the reactor core or fuel element under study, a total of 7,920 holes were bored at ½ in. intervals over the horizontal surface of the tank.

Sperry Products, Inc., Danbury, Conn., reports that new knowledge of the fatigue strengths of materials is being built up by the use of its Ultrasonic Attenuation Comparator. Echo patterns on an oscilloscope viewing screen are compared with a calibrated exponential decay curve. The instrument has been used to investigate hydrogen embrittlement in metals, internal oxidation, nuclear radiation damage, magnetic properties, plastic deformation and dislocation damage.

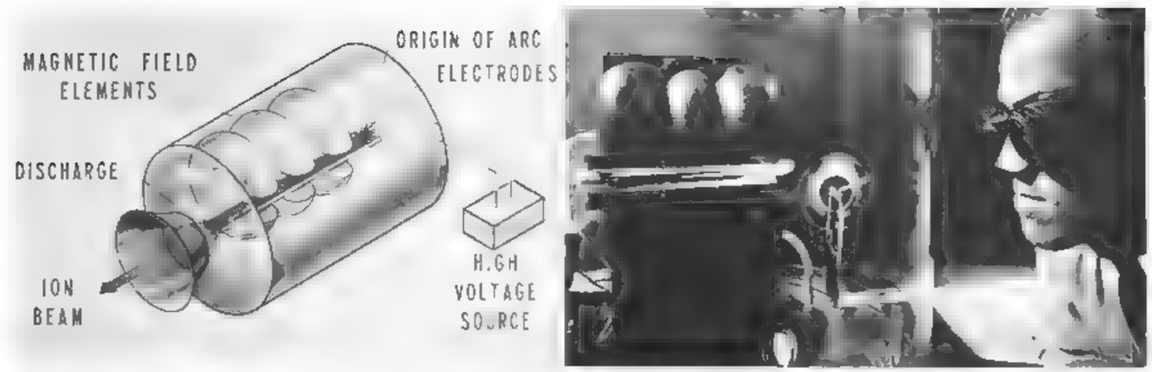
Shown ready to absorb the 825 shp output of a Lycoming T53 gas turbine, Industrial Engineering Company's Model WWX-650 Hydra-Brake is reportedly able to absorb up to 3,000 shp at 7,000 rpm. continuously. Hydra-



Brake is 12 in. long, 20 in. dia., and weighs less than 300 lb. Industrial Engineering, located in Philadelphia, Pa., says that a comparable electric dynamometer would be a 6 ft. cube and weigh 7 tons. Cost is one-third that of an electric dynamometer.

E. I. du Pont de Nemours & Co. claims that in recent tests on an anti-submarine patrol blimp, a skin of coated Dacron polyester fiber was found to reduce the helium loss to one-half of that in regular blimp envelopes. Material comprised two fabric layers of Dacron combined with an inside coating of neoprene, a binding layer of neoprene, and an outside coating of aluminized Hypalon synthetic rubber. Total weight of the laminated cloth was approximately 15½ oz./sq. yd.

Solar Aircraft Co., San Diego, Calif., licensed the Swedlow Plastics Co. Los Angeles, to manufacture and sell its resistance-welded stainless steel honeycomb core in the United States and Canada.



FIRST NACA study model of an ionic propulsion unit drives a small turbine (right) to show it is producing thrust (about 1/4,200 lb.) Unit is operating inside an evacuated bell jar. Schematic of its operation is shown at left.

How NACA Views Future for Propulsion

By J. S. Butz, Jr

Cleveland, Ohio—Present problems and future development possibilities of aircraft and space propulsion systems—including Mach 4 turbojets and ionic engines—were discussed here during the Inspection of the NACA's Lewis Flight Propulsion Laboratory.

The ionic engine, a low-thrust powerplant for use in space, is a fundamental investigation and the project is in its infancy. But it has the same long range purpose as all NACA work, to provide basic data which can be applied to actual design problems by the nation's engineers.

Other activity in progress at the Lewis Laboratory:

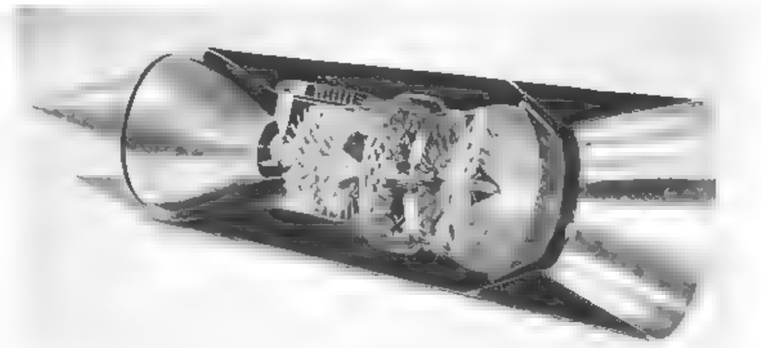
- **Turbojet** operation up to Mach 4
- **Hypersonic propulsion** (above Mach 5)
- **High temperature** materials
- **High energy** fuel-oxidant combinations for rocket engines
- **High energy** fuels for air-breathing engines.
- **Atomic powerplants** for aircraft
- **Turbojet noise.**

Mach 4 Turbojet

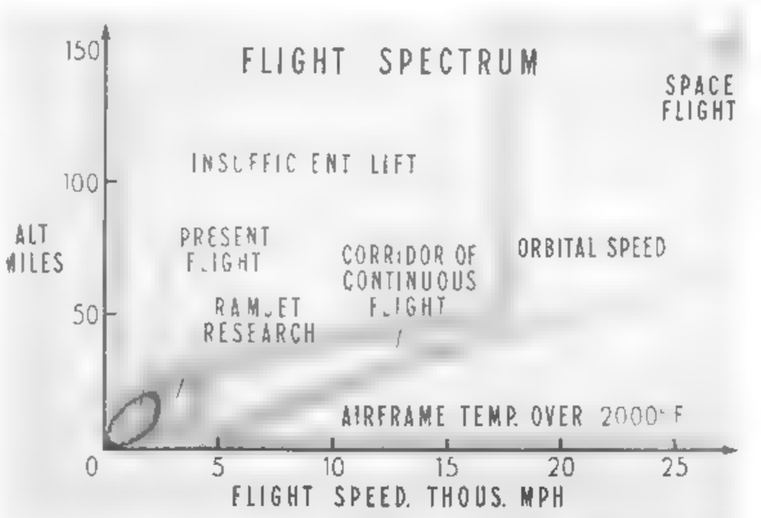
NACA believes that the speed capability of turbojets, once thought to be limited to subsonic levels operationally, can be pushed to about four times the speed of sound—about 2,600 mph. at altitude. This speed, NACA believes, may be the ultimate capability of turbojets.

This Mach 4 engine will differ significantly from today's turbojets. Its inlet and exhaust systems will have to have variable geometry to maintain acceptable efficiency over its whole operating range.

The engine's effective thrust can be severely limited by pressure losses in



MACH 4 turbojet model reflects NACA studies. It has variable geometry inlet and exit, three stage compressor and very short combustion chamber and afterburner.



NACA estimates that aircraft will have to stay in the continuous flight corridor (above) to be aerodynamically and economically efficient. Flight above the corridor requires very large engines and wings. Structural cooling problems are too prominent below the corridor.

the [illegible] thrust system, [illegible] spilling out of the inlet and improper expansion in the exhaust nozzle. These effects can be minimized at all speeds with variable geometry systems.

The compressor section will have perhaps three rotating stages compared to 12 or 15 for some of today's engines. Ram compression in the inlet will be so high that a small pressure rise across the compressor will be sufficient. Transonic design principles have been clarified and have improved the compressor efficiency in this range. Compressor blades will have to be made of high temperature material similar to the turbine blades.

Combustion chambers and afterburners will be much shorter than present ones. Improvements in fuels as well as combustion chamber design make this possible.

Hypersonic Propulsion

NACA also is studying hypersonic propulsion, which involves systems for delivering continuous power to vehicles at speeds above Mach 5.

In broad terms the NACA sees such vehicles traveling in the continuous flight corridor illustrated on page 73. This corridor is the region in which very high speed, very high altitude flight is considered aerodynamically and economically feasible. Flight in the area above the corridor requires greater wing area, structural weight and larger engines lowering the vehicle's range markedly. Below the corridor structural soundness of the aircraft would be jeopardized by aerodynamic heating.

The only air breathing engine presently considered for use at hypersonic speeds is the ramjet. The NACA is studying its behavior from 2,700 to 4,600 mph. Two problems are paramount in this study. One is the cooling of engine parts, and other is conversion of the energy released by burning fuel into useful thrust.

Ramjet Cooling

Cooling problem is illustrated by conditions in the ramjet at a forward speed of 3-4,000 mph. Temperature in the combustion chamber is about 5,000F which is above the melting point of most of today's metals. NACA studies of cooling these internal parts show that the best way is to use fuel and then burn it in the combustor.

The other problem of producing thrust from the burning fuel grows more complicated as velocity increases. Below Mach 2 thrust in a jet engine is generated by increasing the temperature and consequently the velocity of the air passing through the engine. NACA estimates that at a flight speed of 6,300 mph. the temperature rise that the fuel can impart to the air will

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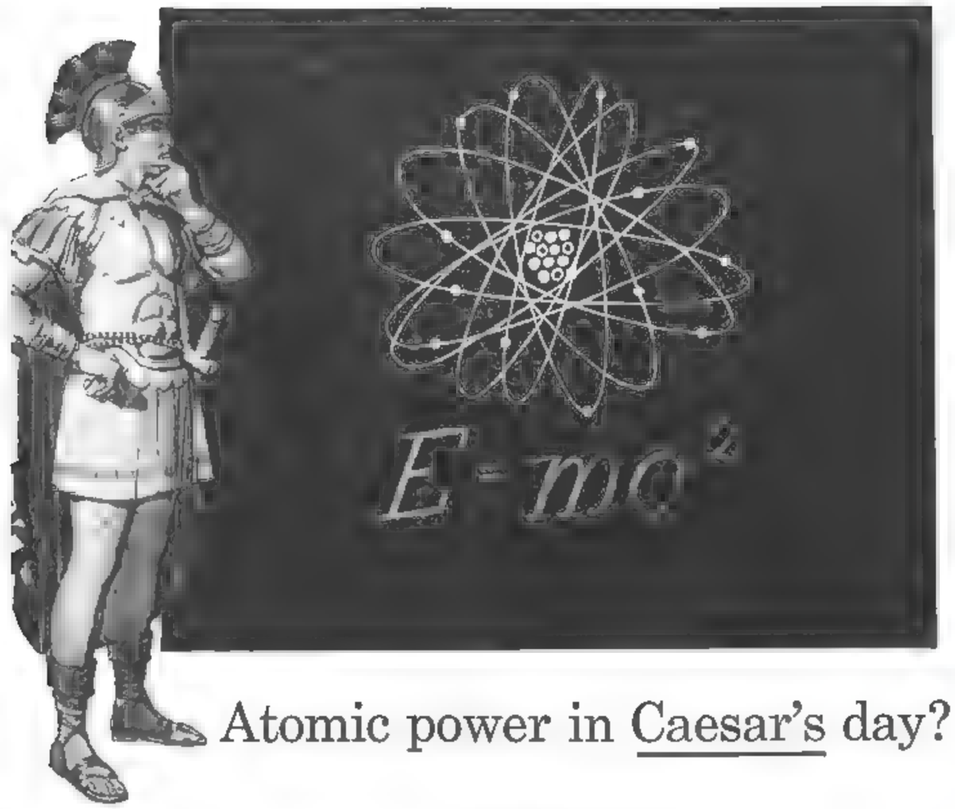

Atomic power in Caesar's day?

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It was there, in the ground, in the air and water. It always had been. There are no more "raw materials" today than there were when Rome ruled the world.

The only thing new is knowledge . . . knowledge of how to get at and rearrange raw materials. Every invention of modern times was "available" to Rameses, Caesar, Charlemagne.

In this sense, then, we have available *today* in existing raw materials the inventions that can make our lives longer, happier, and inconceivably easier. We need only *knowledge* to bring them into reality.

Could there possibly be a better argument for the strengthening of our *sources* of knowledge—our colleges and universities? Can we possibly deny that the welfare, progress—indeed the very *fate*—of our nation depends on the quality of knowledge generated and transmitted by these institutions of higher learning?

It is almost unbelievable that a society such as ours, which has profited so vastly from an accelerated accumulation of knowledge, should allow anything to threaten the wellsprings of our learning.

Yet this is the case

The crisis that confronts our colleges today threatens to weaken seriously their ability to produce the kind of graduates who can assimilate and carry forward our rich heritage of learning.

The crisis is composed of several elements: a salary scale that is driving away from teaching the kind of mind *most qualified* to teach; overcrowded classrooms; and a mounting pressure for enrollment that will *double* by 1967.

In a very real sense our personal and national progress depends on our colleges. They *must* have our aid.

Help the colleges or universities of your choice. Help them plan for stronger faculties and expansion. The returns will be greater than you think.

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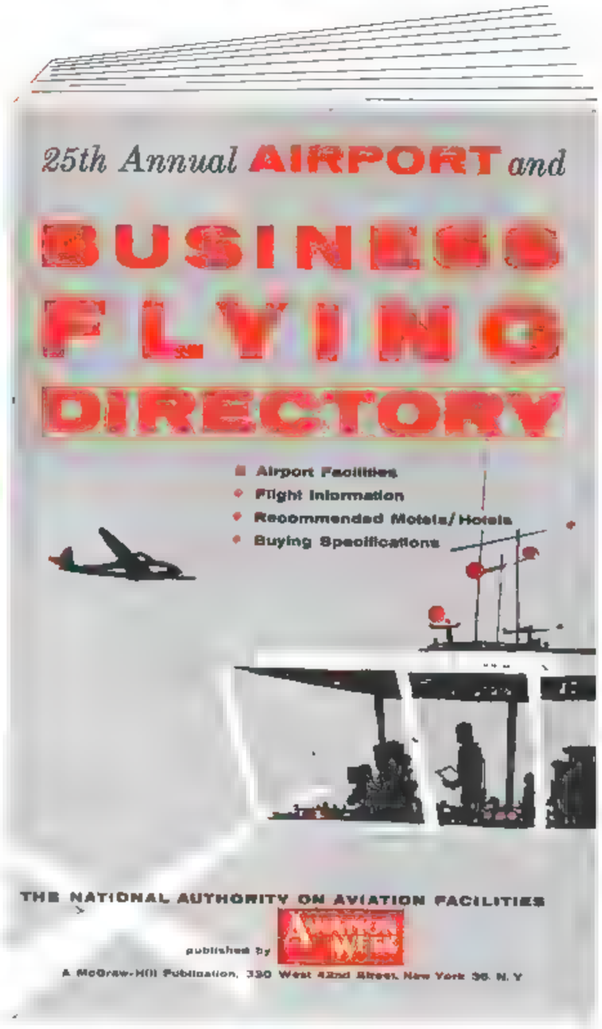
- U.S. and Foreign Entry, Exit Requirements
- ADIZ Map
- Equipment Illustrations; Buying Specifications



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be zero. However this excess of atoms that the engine can no longer produce thrust

At a flight speed of 6,300 mph all of the air entering the combustion chamber has been heated to its dissociation temperature. The energy released by the burning fuel is all consumed in the dissociation process which splits the bonds holding the atoms of the various gas molecules together. The only way to recover the fuel energy consumed by dissociation and make it produce usable thrust is to have the atoms recombine into their molecules within the engine. Recombination takes place when the air is expanded and its temperature lowered

Nozzle Geometry

The proper length and geometry for a nozzle with maximum recombination benefits are being studied by the NACA

Dissociation losses begin to be a major consideration in ramjet and turbojet design just above Mach 2. They can amount to a 50% loss in thrust at about 5,000 mph.

Ionic propulsion studies which have recently been initiated by the NACA are intended for use on vehicles which have reached orbital velocity. They are low-thrust engines which might have use on long voyages into space because of their very low fuel consumption. Primary drawbacks are heavy weight and need for electric power.

Their operating cycle consists of striking an electric arc in a gas. The arc ionizes the gas and these charged particles are accelerated by a magnetic field producing a thrust. The thrust of a feasible unit would probably be very small. However, its specific impulse would be very high and its fuel consumption low. The electricity required by the ionic rocket for space travel would probably be produced by a unit using atomic or solar power

Weight Problem

The ionic rocket could possibly become attractive for space travel when its total motor weight approached the total motor weight for a chemical rocket or other competitive powerplant. If this is achieved, a great advantage would be with the ionic rocket because most of its motor weight is heavy electrical machinery in contrast to the great propellant weight of a chemical rocket. If many flights were to be made with the space vehicle the fuel resupply problem of the ionic rocket would be practically nil. With the chemical rocket however it would be tremendous

The very low thrust of the ionic engines is a serious disadvantage and would have to be weighed against the refueling and other benefits. Low thrust greatly increases travel times in space.

...it ... great velocity changes can be effected and control problems of the space ship's trajectory would be minimized because of the long burning times. Some figures on the low-thrust long-burning time approach were given in an NACA example. If a 10 ton space vehicle were powered by a 10 lb. thrust engine for one month, it would increase its original velocity by over 25,000 mph.

The small ionic unit demonstrated during the Lewis tour is the first one constructed at the Laboratory. It produced about 1/4 lb thrust needed 1,000 volts to start, operated at about 500 volts and .5 amps. It was run in a bell jar evacuated to simulate an altitude of 80,000 to 100,000 ft. In this way air was used as the fuel. In space a gas would be carried along as fuel. The stream of ions drove a small turbine made of several sheets of mica to show that it was producing thrust.

Plasma jets operating on this same principle are also used by the NACA to test materials in the type of high temperature ionized gas stream that they would encounter during re-entry. The plasma jet is also a feasible low-thrust, low fuel consumption device for space propulsion.

High Temperature Materials

Progress with all types of propulsion units as larger wing ... proved structural materials. Some goals of metallurgical research are to raise maximum use temperatures of

- **Turbojet blade materials** from about 1,650F to 2,500F.
- **Ramjet materials** from 2,500F to 3,100F.
- **Nuclear rocket materials** to 5,000F.

One method of increasing high temperature strength of current nickel and cobalt base alloys is to suspend ... ing particles in the material. These particles have roughly the same effect on the strength of the alloy as the ... of gravel does in concrete. The effect of these high temperature hardening particles is demonstrated by the results achieved by suspending finely divided stable ceramic-aluminum oxide in a nickel matrix. This raises the use temperature of the nickel base alloy from the current figure of about 1,650F to as high as 2,100F.

Use of a refractory powder in aluminum alloys has raised the capabilities of aluminum several hundred degrees.

The use of nickel and cobalt base materials is limited, however, by their low melting points. The nickel base alloys are liquid at about 2,600F. Other metals with higher melting points must be used as base materials for higher temperature alloys.

Two metals currently being considered as base materials are columbium with a melting temperature of 4,500F and tungsten which melts at 6,100F.

Tungsten alloys can be expected to sustain 10,000 psi. stress at temperatures 1,700F higher than nickel alloys.

The entire class of high melting point metals have the very serious problem of rapid oxidation. When heated the surfaces of these metals will react ... combine rapidly with oxygen.

Oxidation rate is greatly increased in an atmosphere of ionized air such as would be found around a high speed missile nose cone or in an atomic engine. Rise in oxidation rate is due to the more active nature of the air after its molecules have been dissociated into charged particles. These particles want to recombine into more stable molecules and this is done against the metal. Recombination releases heat, further raising the metal temperature and increasing oxidation still more. Metals oxidize about 400 times faster in the presence of dissociated air than in normal air. NACA research in this area to date has been to define the problem, now measures of countering this severe oxidation are being studied.

Another group of materials being investigated at Lewis are ceramics which have very high melting points and good oxidation resistance but are handicapped by brittleness.

One of the most serious effects of brittleness is susceptibility to thermal stresses which are high in many missile and atomic applications.

Research at Lewis and elsewhere indicates that some ceramics may be inherently ductile and that their brittleness is due to surface imperfections.

Careful treatment and polishing of ceramic surfaces have greatly increased their ductility. This work has essentially just begun and practical methods of treating large sections of ceramics are not available.

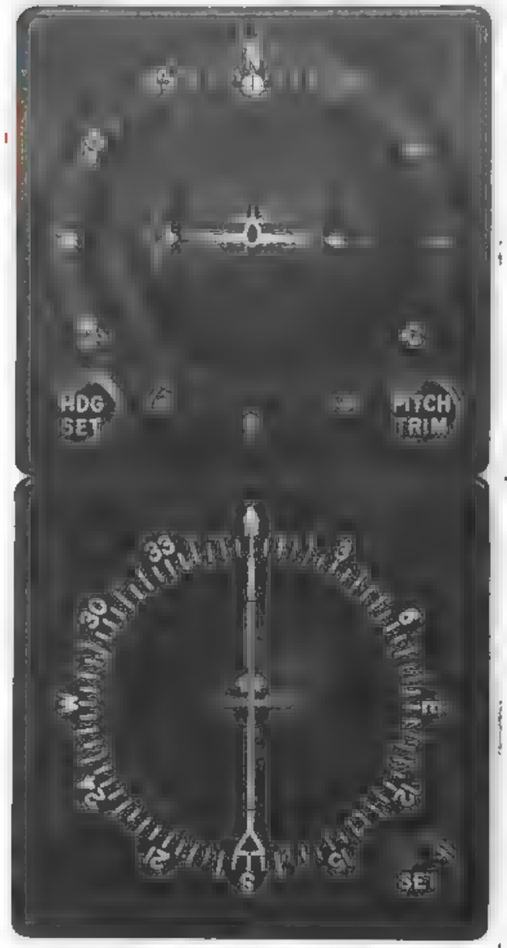
High Energy Propellants

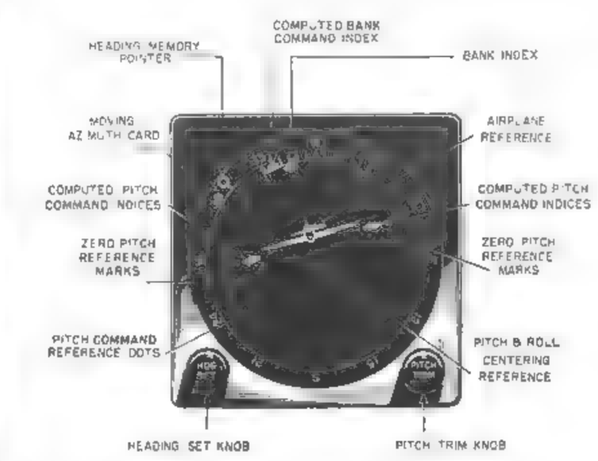
NACA's rocket research effort is almost completely centered about high energy fuels and oxidizers. Experimentation includes the most highly reactive and dangerous substances which are potentially the best propellants.

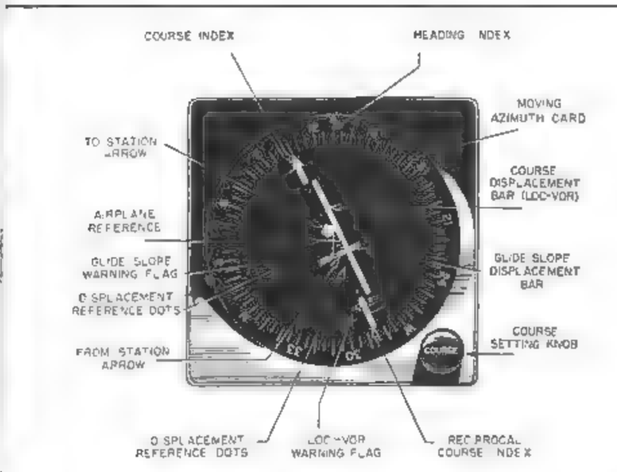
Practical studies are being made of the difficulties of using hydrogen fluorine combination. This is typical of the work at Lewis Laboratory.

Fluorine is the most powerful oxidizer known and consequently reacts readily with most materials, often violently. One problem in its use is to find material for tanks, valves and lines in the fuel feed system which will contain the fluorine. Rocket combustion chamber and nozzle construction problems are magnified by use of fluorine.

Hydrogen is most difficult to keep in the liquid state, it boils at −423F. Well insulated tanks and lines are needed to keep the hydrogen supply system working properly.







LEAR integrated flight instruments, used with new L-102 jetliner autopilot, include NaFli indicator (top views) which displays aircraft heading, pitch and bank attitude using miniature moving airplane, and flight director steering commands. Course indicator (bottom views) displays aircraft heading and aircraft position relative to ILS localizer, glide slope and VOR beams.

Lear Aims Dual Autopilot at Civil Jets

By Philip J. Klass

Santa Monica, Calif.—Lear will soon make an open bid for the jetliner flight control market with a new operational concept, a new automatic pilot and a new type of integrated flight instrument display.

- **New concept:** Dual autopilot installations are an operational and economic requirement for new jetliners, but need not involve any size, weight penalty.
- **New autopilot:** Lear's L-102 light weight, all-transistor flight control system designed for the jet transport field.
- **New flight instrument:** Combines magnetic heading, pitch and bank attitude, plus flight director steering instructions, in a distinctive, easily interpreted cockpit display.

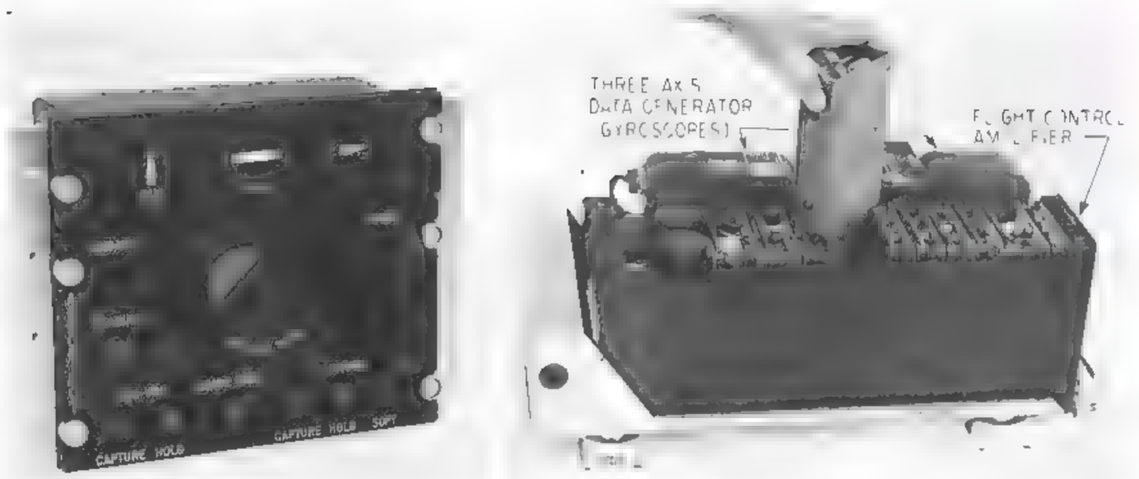
The L-102 is slated for use in the Scandinavian Airlines System Caravelles, is installed in the new Lockheed CL-329 Jetstar utility jet transport, and Lear holds several orders for L-102s for the Fairchild Friendship F-27.

Changed Thinking

Lear's "duality" philosophy is a logical extension of the change in thinking that has taken place in the past five years on the role of an autopilot. Once viewed as a luxury item, the autopilot is now accepted as just the opposite—a device that provides significant operating economies even in present-day piston-engine aircraft.

The autopilot and its approach coupler have reduced the number of missed approaches under adverse weather conditions and permit the lowering of instrument landing minimums for autopilot-equipped aircraft. For long nonstop flights, the autopilot prevents porpoising with resultant saving in fuel and flight time.

One indication of the importance of autopilots to airline pilots is the clause in American Airlines' contract with the Air Line Pilots Association which gives its DC-7 captains the right to refuse to take off in an airplane whose auto-



L-102 autopilot flight controller, left, mounts in cockpit console. Autopilot amplifier and gyro instruments fit in 1 ATR-size rack, weigh only 45 lb. L-102 is completely transistorized, uses printed circuitry, plug-in sub-assemblies.

pilot is not functioning properly.

For the new jetliners these factors loom even larger. Fuel management is far more critical and the price of a missed approach with low fuel reserves can be far higher than for today's aircraft.

Based on military jet aircraft experience, the new jetliners may have an even more critical need for an autopilot-to damp out undesirable yaw oscillations. The question of whether a jetliner can be dispatched or flown for extended periods without a functioning autopilot, or at least a functioning yaw damper, is for dispute until initial flight tests and Civil Aeronautics Administration certification.

If yaw damping should prove an operational or mandatory requirement, manufacturers may be forced to add a separate yaw damper system (roughly ½ of an autopilot) as an autopilot back-up.

Boeing reportedly has decided to add a separate yaw damper on its KC-135 jet tankers for this purpose.

Growing Duality

There are other indications of the trend toward duality in jetliners. Most are being outfitted with an integrated autopilot and flight instrument system. Dual sets of gyro references are provided, one for the flight instruments, the other for the autopilot. In event of gyro failure, both flight instruments and autopilot can be operated from the second set.

Eclipse-Pioneer's PB-20 flight control system, slated for use on the Boeing 707, employs an automatic malfunction detector—which is almost a separate autopilot in itself, except for servo actuators—to monitor performance of the regular autopilot.

Lear now carries this trend to what the company believes is the logical conclusion by proposing the installation of two completely separate automatic pilots, each capable of independent operation to provide full back-up in the event one system malfunctions.

Capt. R. C. Robson, speaking as a pilot in his AVIATION WEEK column, Cockpit Viewpoint (see p. 47), fully supports the philosophy of autopilot duality. With only a single autopilot aboard, malfunction "could mean inability to dispatch the aircraft . . . (or) uneconomical flight to the next repair station." Speaking of the possibility of autopilot malfunction during an automatic ILS approach, Robson says, "this is no place to experience a quick disconnection and have the 'bottom drop out' . . . I should be much obliged if a stand-by unit would automatically take over and continue uninterrupted flight."

Robson concludes with the prediction that "a stand-by autopilot will eventually be a definite requirement for airline operations."

Another advantage of autopilot duality is economy, according to James P. Brown, Lear's western area manager. Brown says it is cheaper to carry a spare operational autopilot on board than to stock spare parts and qualified maintenance personnel at every way station.

Although Lear is the first manufacturer to propose autopilot duality, it will have no monopoly on the concept. Sperry Gyroscope Co., whose SP-30 flight control system will go on the Douglas DC-8, and Eclipse Pioneer both would be more than willing to sell dual autopilot installations. Where dual gyro references are already planned for integrated flight instruments, only an additional 85 to 100 lb. of equipment would be required.

But because of the lightweight design of the L-102, Lear says it can provide dual autopilot installations for the same or even less weight than the single autopilot (plus dual instrumentation) installations of its competitors.

What Lear Installs

For an uninstalled weight of about 210 lb., Lear says it can provide two completely independent autopilot and integrated flight systems, including dual sets of servo actuators. (Exact weight depends upon particular airplane configuration.)

The L-102 provides all of the convenient operational features that characterize recent vintage autopilots, plus several new ones. Highlight features include:

- **Automatic synchronization,** which permits autopilot to be engaged with aircraft in any attitude, maintains airplane pitch attitude and heading.
- **Altitude control** which maintains airplane barometric altitude at value existing when control is actuated.
- **Heading selector** which enables pilot to set in new heading and causes autopilot to smoothly maneuver airplane onto selected heading.
- **ILS-VOR beam coupler** which provides automatic instrument approaches and permits automatic flight along VOR airways. Automatic limiting of maximum bank angle is provided during instrument approach.
- **Automatic pitch trim,** through auxiliary servo actuator, maintains elevator in continuous trim condition. Automatic yaw trim can also be provided as optional feature but is not included in the 210 lb. weight figure.
- **Airspeed/Mach number control,** an-

Only the men are flying

The fact is, men beat birds at their own game. Even when our feathered friends are grounded, we're aloft, flying ever higher, faster, safer, further. And, unbelievable as it may seem, more accurately

Among the companies spearheading man's conquest of the sky are nine of the GPE Group Their contributions are basic technological bench marks such as—

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• the only airborne navigation systems in operational use guiding planes automatically and with unprecedented accuracy — anywhere, in any weather: GPL Doppler autonavigators.

Inertial navigation, missile guidance, photoscience, and certain nuclear power applications, are some other phases of aviation in which GPE companies are deeply and jointly involved. And while many of the products of the GPE companies — particularly in the field of aviation—serve defense needs today, the important scientific advances they embody are "plowshares" for tomorrow.

Aviation is but one industry in which GPE companies work. A brochure describing the activities of the group is available. More than a dozen basic industries are served by products resulting from GPE coordinated technologies and resources.

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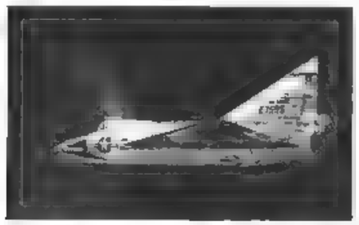
man aloft

The pilot — before he set eyes on this jet, before he set hand to the actual controls — had already flown it. He learned how, on the ground in a Link F-102 Simulator one of more than a million fliers who have logged "Link time." Millions more will.



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other optional feature which adds about 1½ lb., will maintain aircraft at any desired airspeed

• **Yaw damping function** only can be provided when pilot desires to fly airplane manually

Altitude Selector

One of the L-102 innovations is an altitude-capture control. This enables a pilot cruising at one altitude to set in another altitude on a small selector, push a button, and the aircraft will then automatically climb or descend until it reaches selected altitude, level out and hold this altitude without further attention by the pilot. Lear believes this altitude-capture feature will be of considerable assistance during laddering-down operations in instrument weather holding stacks.

Another innovation is that the pilot is able to select either regular or "soft" altitude control. The latter is intended for use under turbulent air conditions

Because cockpit console space is at a premium, Lear has built a dual flight controller into a single device. However, all internal switches, synchros and other controls are built in duplicate-tandem fashion to give complete circuit independence and prevent a malfunction in one autopilot from incapacitating the other.

Integrated Flight Instruments

The dual L-102 flight control system weight of 210 lb. includes two sets of three flight instruments

• **Course indicator** which gives semi-pictorial presentation of aircraft bearing and position relative to VOR or localizer beam. Face of this instrument resembles Collins and Sperry course indicators except that it has an additional horizontal needle which displays aircraft position relative to glide slope beam during an instrument approach

• **Conventional RMI** indicator which displays aircraft magnetic heading and airplane bearing to two VOR/ADF stations

• **NaFli (natural flight) computer indicator,** which displays airplane heading, pitch and bank attitude and flight director steering commands. This is first commercial instrument to combine functions of separate directional gyro, horizon gyro and ILS cross-pointer indicator in single instrument.

NaFli Innovation

The NaFli indicator incorporates another significant departure from existing flight instruments in its display of pitch and bank attitude. In a conventional horizon indicator, when the airplane banks the instrument's miniature horizon moves relative to fixed indices on the instrument which represent the airplane. This is intended to give the pilot the feeling of looking out the windshield and seeing the horizon move as the airplane banks. However, there are many who question how effectively the miniature indicator simulates actual observation of the true horizon

Lear is one of these doubting Thomases and has therefore used a miniature airplane which banks, climbs

NEW LOCKHEED Jetstar (CL-329), light utility jet transport, is equipped with Lear L-102 autopilot. Autopilot and other avionics are located in nose section.

or dives relative to fixed instrument indices. The effect is the same as if the pilot were fixed in space, viewing the maneuvers of his own airplane from the rear. In the belief that this is a more natural type of display for both the experienced and inexperienced pilot, Lear calls the instrument NaFh (natural flight).

Airplane heading is displayed on a moving card (dial) around the periphery of the instrument. The combination of airplane bank and heading display on a single instrument provides a natural combination of two closely related functions inasmuch as a roll maneuver produces a change of heading.

To take up a new heading, the pilot merely banks the airplane so that a small half-circle bank index moves in the direction of the desired heading. (See sketch, p. 85.) As the aircraft turns, the outer heading dial rotates. When the desired heading on the dial is opposite the bank index, the pilot begins to roll out, keeping the bank index and desired heading aligned. This brings aircraft out of the turn on the desired heading.

Flight Director Commands

The NaFh indicator employs a distinctive display for flight director steering commands. To display flight up-down commands during an instrument approach, two small diamond shaped indices, resembling wing-tip tanks, move up and down relative to the wings of the miniature airplane. When the airplane is properly executing the flight director commands, the two indices appear to be wing tip tanks attached to the miniature airplane's wings. When the flight director is calling for a diving or climbing attitude, the diamond indices are below or above the miniature airplane.

Flight director commands for a change in heading are displayed on another half-circle index which moves around the inner periphery of the heading scale. When the flight director calls for a change of heading (bank angle), the pilot maneuvers until the previously mentioned bank index half-circle is aligned with the bank command half-circle index, rolling out as required to keep the two aligned.

The L-102, like most of the newer flight control systems, is completely transistorized, with resultant savings in size, weight and power consumption.

Compact Installation

The directional and vertical gyros and related control amplifiers required for a single L-102 autopilot installation are mounted on a ½ ATR-size rack which weighs about 25½ lb. All of the main autopilot servo amplifiers, approach control coupler and related controls are mounted on another ½ ATR rack which weighs 20 lb. Individual amplifier sub-assemblies are plug-in types, employing printed circuitry and sandwich type construction. (See photo, p. 86.)

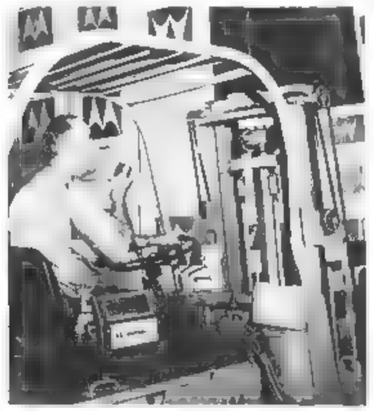
The L-102 uses the electric motor-driven servo with magnetic clutches which Lear pioneered for autopilot use in its military F-5 autopilot. The servo motor runs continuously but is connected to the output capstan only when one of the two magnetic clutches is energized by the servo amplifier. Servo response is extremely fast because the motor need not accelerate from a dead stop.

When autopilot is turned off, servo capstan normally rotates freely without loading down airplane's control system. However, to be doubly sure of disengagement, the L-102 servos also employ a solenoid-operated electrical disconnect which disengages capstan from the rest of the servo actuator.

Mechanism for Overpowering

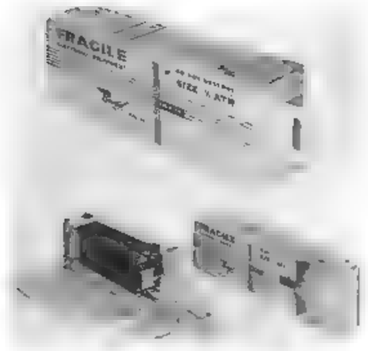
In an emergency, the pilot's first reaction is to overpower the autopilot, then turn it off. Lear provides two means for overpowering the autopilot servo actuators. One is a ball-detent arrangement in the solenoid engaging mechanism; the other is a clutch in the servo drum which can be adjusted to slip at any desired value of pilot overpowering force.

The L-102 dual system does not at present incorporate provisions which enable one autopilot to monitor the performance of the other and which automatically disconnect the latter in



Transistor Unit

Transistorized two-way radiophone, which reduces power consumption to as little as six ampere hours for eight hours of operation, is available in two models, one for the 25-50 mc. band, the other for the 152-174 mc. band. Device is available for variety of operating voltages, from 6 v.d.c. to 117 v.a.c., occupies a volume of only ¼ cu. ft. Manufacturer: Motorola, Inc., 4501 West August Blvd., Chicago 51, Ill.



Reusable Box

Bendix Radio is now packaging its airline avionics units in new handy cardboard container which can be reused as many as 25 times for reshipment of spare units from central supply to outlying stations. Container was developed by Bendix in cooperation with Air Transport Association

event of failure. Such an arrangement is technically possible but may not be operationally feasible, according to Brown. He points out that a "difference of opinion" between the operating and monitoring autopilot would not necessarily indicate which is at fault.

Brown is inclined to believe that the decision to disengage one autopilot and switch to the other should be made by the human pilot. The two autopilots will both be energized and in operation throughout a flight, except for the servo actuators of the standby, which would be disengaged. A flick of a switch will instantly transfer control to the standby.

Expansions, Changes In Avionics Industry

Digital Equipment Corporation, Maynard, Mass., is newly formed company which will develop and manufacture testing equipment for computer manufacturers. Company is headed by Kenneth H. Olsen, president and Harlan E. Anderson, vice president. Both are former members of Lincoln Laboratory where they worked on SAGE air defense computer systems. Company's address: Main Street.

Other recently announced changes and expansions in the avionics industry include:

• **Texas Instruments Ltd.,** wholly owned British subsidiary of Texas Instruments Inc., Dallas, has opened new semiconductor manufacturing facility in Bedford, England.

• **Norden-Ketay** has moved its Gyromechanisms division to new 17,000 sq. ft. building at Huntington Station, N. Y., and has completed new 31,000 sq. ft. addition to the Commack, N. Y.,

4000 HOURS OF TESTING SHOWS GENERAL ELECTRIC T58 ENGINE HAS

PROVEN

PERFORMANCE

Military guarantees—1024 hp, 0.66 SFC—proved by unofficial Model Tests. And these performance guarantees have been bettered in engines shipped for customer use by as much as 90 hp and 0.02 SFC! Performance? Definitely. But not at the expense of engine weight and size, for with reduction gear and ready to fly, the T58 weighs only 325 lbs; measures just 59 inches long and 16 inches in diameter. Its high power weight ratio and low SFC offer helicopters outstanding improvement in their performance and operating efficiency.

RELIABILITY

Reliability of the T58 is based on the extraordinary dura bility its components have demonstrated in over 4000 hours of development testing. Typical results are (1) no catastrophic failures, (2) no compressor or turbine bursts, (3) no trace of combustor deterioration in unofficial Model Tests, (4) no demonstrated effects on compressor life as a result of deliberately induced stalls! Yet, this is just part of the T58's record of ruggedness. In special weather tests, the T58 demonstrated its ability to start in sub zero temperatures and operate under severe icing conditions

CONTROL STABILITY

To prove the stability of the T58's controls and their responsiveness to a helicopter rotor system, General Electric has subjected the T58 to over 150 hours of tests on this rotor stand. Despite throttle bursts and sudden collective pitch increases, the engine's control system kept power turbine speed loss to as little as 1%! At the same time, the gas generator and power turbine regained efficient operating speeds as fast as 4 seconds! Here, certainly, is proof that the T58 can provide extremely accurate rotor-speed command, more efficient helicopter operation.

POWER SPLITTING

The T58's excellent power-splitting ability makes twin turbine-powered helicopter flight truly practical. Dual engine runs show the T58's control (1) automatically proportions output of both engines, at any collective pitch setting, (2) allows full military power to be drawn from both engines, (3) holds power differential between engines, at all collective pitch settings, to a minimum, (4) virtually eliminates manual rotor speed adjustment, (5) prevents excessive engine or rotor speeds. General Electric Company, Section 233-8 Schenectady 5, N. Y.

Rugged development test program, conducted by the Navy's BuAer and General Electric, proves T58 engine is a real "workhorse"—capable of revolutionizing helicopter flight!

Progress Is Our Most Important Product

GENERAL ELECTRIC

plant of its Precision Components division

• **Victoreen Instrument Co.,** Cleveland, has purchased assets and trade name of **Jordan Electronics, Inc.,** Alhambra, Calif., maker of nuclear radiation instruments. Present Jordan management will continue operating new acquisition.

• **Farnsworth Electronics Co.,** Ft Wayne, division of International Telephone & Telegraph Corp., has broken ground for new $3 million manufacturing facility, slated for occupancy by middle of 1958

• **Weston Electrical Instrument Corp.** has opened new district sales office and repair facility in San Francisco at 1417 10th Street.

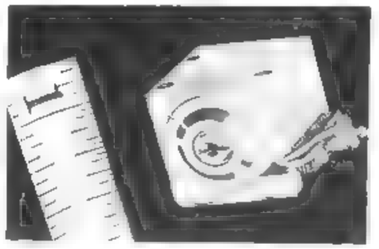
• **Pacific Semiconductors, Inc.,** Culver City, Calif., has added another facility, its fourth, at 10555 Virginia Ave. to house sales and service departments.

• **Ceramatronics, Inc.,** Passaic, N. J., is new company formed to produce high temperature ceramic-to-metal hermetic seal components, printed circuits and various electro-mechanical assemblies Company's address: 364 Highland Ave

NEW AVIONIC PRODUCTS

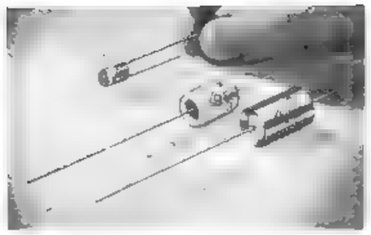
Components & Devices

• Linear-stroke solenoid for test instrumentation and missile control applications weighs under 1 oz. and measures approximately 0.67 x 0.62 x 0.62 in Unit is said by manufacturer to be



shock-resistant and to meet Air Force environmental specifications for fighter installations. Solenoid exerts minimum pull of 6 oz. operating at 28 volts Manufacturer: J. A. Maurer, Inc., 37-01 31st St., Long Island City, N. Y.

• Selenium contact protectors, available in three configurations, eliminate arcing and erosion of relay and switch contacts in most electrical circuits, according to manufacturer. Configurations are: encapsulated diode type occupying 0.01 cu. in., fiber tube cartridge type, and hermetically sealed cartridge type capable of withstanding severe environmental conditions. The d.c. types are



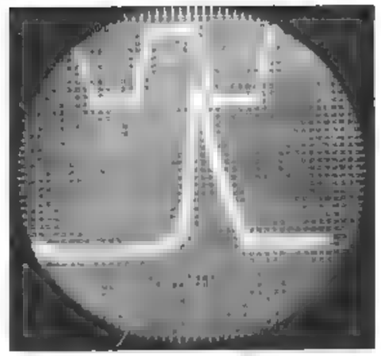
available in voltage ranges from 15 to 154 volts, and maximum coil currents from 250 to 600 ma. Manufacturer: International Rectifier Corp., El Segundo, Cal.

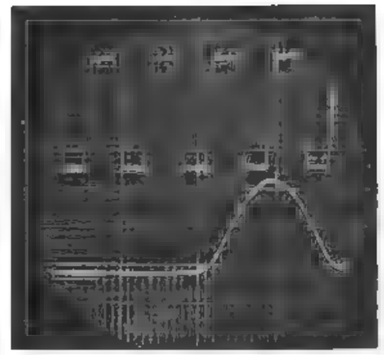
• **Encapsulated wire-wound resistors,** Series EP, are vacuum impregnated and vacuum cast to eliminate hot spots caused by voids in windings. Precision EP series meets MIL-R-93A and MIL-

R-9444. Operating range is from −65 to 125 C with temperature coefficient of ±0.00002 C. Manufacturer: Kelvin Electric Co., 5907 Noble Ave., Van Nuys, Cal.

• **Precision Potentiometer,** called Padohm, is for pad or trim resistance functions. Padohm is available in values from 100 to 20,000 ohms with tolerance of ±10% and linearity of ±2%. Padohm is available in two types: Type L rated at 0.25 watts derated to 0 power at 150 C, and Type H at 0.40 watts derated to 0 at 135 C. Manufacturer: Clarostat Manufacturing Co., Inc., Dover, N. H.

• **High power silicon transistor,** Type 2N451, is 65 volt unit capable of dissipating 85 watts at 25 C. Meeting requirements of MIL-T-19500A, 2N451 has input impedance of 25 ohms with collector current of one amp. (mounting base temperature 25 C), with beta cutoff of 400 kc. Hermetically sealed case is designed for mounting on external heat sink by single thread stud. Manufacturer: Semiconductor Products Department, General Electric, Syracuse, N. Y.





IMPACT shock machine produces, repeats saw tooth, quarter or half sine wave shocks.

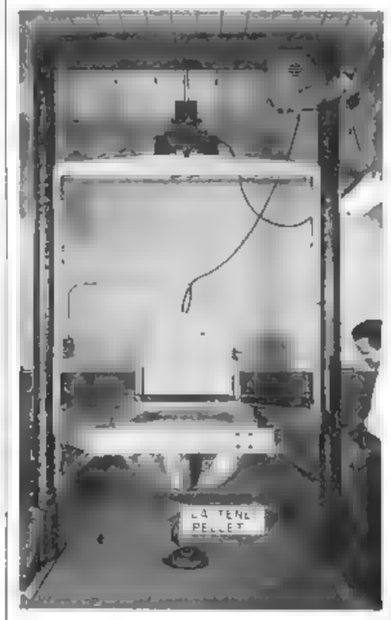
Shock Machine Repeats Patterns

Watertown, Mass.—New shock machine which produces, and can accurately repeat, saw-tooth and other wave shape impacts of more than 100 Gs, over frequency spectrum of 100 to 700 cps., has been developed here by Barry Controls, Inc., for testing ballistic missile equipment.

First of two of the new Type 15000 free-drop shock machines, designed to specifications prepared by the Ramo-Wooldridge Corp., will go to A C Spark Plug division of General Motors and to Bell Telephone Laboratories for testing ballistic missile guidance.

Unlike previous shock machines, whose table (carrying equipment under test) is brought to a stop by hitting sand pit underneath, new Barry tester drop table is halted by striking a soft metal pellet, flattening out the pellet. Choice of pellet material and shape determines wave shape and duration of shock. Company says it can produce, for example, saw-tooth, quarter or half sine wave shocks. (See above.) Use of identical pellets in subsequent drops will produce nearly identical shock wave shapes, Barry says.

Machine can accommodate equipment weighing up to 400 lb. and measuring up to 36 in. square. Maximum drop distance available is about 30 in.



PELLET material, shape influences shock wave

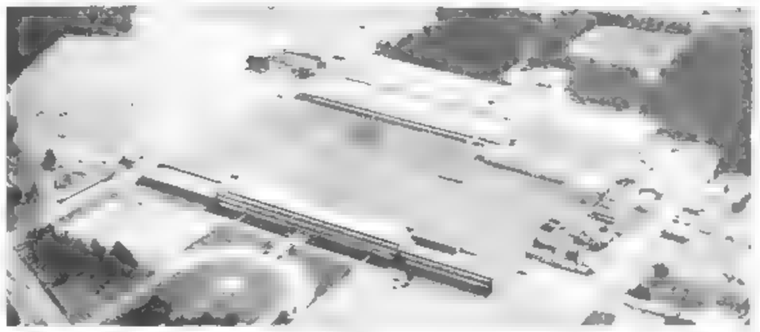
Propeller Firm Expands Accessory Line

By George L. Christian

Windsor Locks, Conn.—Hamilton Standard's diversification program—started 10 years ago in anticipation that jet powered aircraft would cut drastically into military, and eventually commercial, propeller procurement has proved so successful that the company is expanding its line of airborne accessories.

New equipment developments will be tailored to the missile market, Erle Martin, vice president and general manager of Hamilton Standard division, United Aircraft Corp., told AVIATION WEEK.

It was Martin who, in consultation with H. M. Horner, UAC's board chairman, and other corporation officials, made the decision to diversify. Strong supporter of his views was Charles M. Kearns, then engineering manager and now assistant general manager of Hamilton Standard.



AERIAL VIEW of Hamilton Standard's Windsor Locks, Conn., plant. Concrete circle in front is helicopter landing pad, taxiway from nearby Bradley Field comes in at lower right.

Felt Left Out

Martin said, "being a major supplier of aircraft propellers, we had become accustomed to regarding every airplane built as a potential customer of ours. We felt left out of the jet picture. Therefore we decided to diversify in order to have some growth potential while at the same time maintaining our position in the aircraft propeller market."

Yardstick of the healthy impact of the diversification program is the fact that current employment is 11,500, a good 1,500 above the 10,000 World War II peak, and a big jump over the 2,000 employe level when the program was instituted in 1948.

First airborne accessory to go into production as a result of the company's diversification program was a 25 lb. cockpit air cycle air conditioning unit for North American Aviation's F-86D fighter.

This was a logical decision since in designing the air cycle machine Hamilton Standard's engineers could lean heavily on their large background of aerodynamics gleaned from years of designing, developing and producing propellers.

Accessory Products

Accessory lines were soon expanded to encompass jet engine starters, fuel controls, high pressure hydraulic pumps and avionic components.

Martin pointed out that the overall similarities between certain jet plane accessories and missile equipment packages makes the transition from one to the other a natural development step.

Example is a solid propellant electrical and hydraulic power package which the company developed for a missile. It was a natural outgrowth of its line of cartridge engine starters.

Controls for rocket and exotic fuel engines will be a logical next step for the company's experience in building increasingly complex jet engine fuel controls of both hydromechanical and electronic types.

Hamilton Standard is currently doing work on controls for unconventional fuels and powerplants.

Electronics section of the company has ambitions to expand into missile control and guidance systems. But, says Martin, he wants it to start with smaller jobs and work up to the more complex avionic systems.

Hamilton Standard's background in air cycle air conditioning systems enabled it to compete successfully for cooling systems installed in such air breathing missiles as the Northrop Snark and Chance Vought Regulus II.

Mechanical constant drives (AW Aug. 5, p. 87) are being developed at the company's St. Petersburg, Fla., research and development facility. Some are now being test run.

Spurred by Sputnik

Decision to swing more heavily into the missile market seems well justified by recent developments. Martin feels that the sudden appearance of the Russian-launched satellite, Sputnik, will certainly accelerate the trend to missiles in the U.S. This will provide increasingly large markets for the company's developments in missile accessories and components.

While the company is continuing its search for new and expanding markets, there is no possibility that it will follow the example of some other members of the aviation manufacturing fraternity and move into non-aviation fields, such as the automotive industry. Reason, says Martin, is that UAC's former chairman, Frederick B. Rentschler, established long ago the uncompromising principle that all of the corporation's divisions would stay in the aviation industry exclusively because diversions into other industries would reduce their competence to produce to precise tolerances and high degree of workmanship which has become the hallmark of the aviation industry.

Tough Competition

Martin summed up his views by pointing out that the company had, and has, a tough competitive situation to face in every one of its accessory fields. Among the many firms against which he has to do economic battle are: General Electric, several divisions of Bendix Aviation Corp., Holley Carburetor Co., Vickers, Inc., The New York Air Brake Co., and Stratos division, Fairchild Engine & Airplane Co., to say nothing of Curtiss and Allison in the propeller field. Result of this rigorous competition is a beneficial cost reduction to the equipment buyers and users. Price of pneumatic jet engine starters, for example, has decreased almost two-thirds, from over $3,000 per unit to something like $1,200.

As soon as the company's management was firmly committed to the diversification program, came the difficult task of selecting what products to be made.

Decisions were based on the company's store of knowledge, skills and machinery.

Air cycle air conditioning seemed a logical start because of the company's many years of experience in the field of aerodynamics because of its propeller research, development and manufacture.

Company hired a consultant whose market survey indicated that, in the aviation field, air cycle refrigeration systems had most promise for the immediate future (1948), but that freon systems would come along later. This forecast has been well borne out by events.

Although the consultant's survey indicated that the market volume for aircraft cooling systems would be low, company executives decided to go ahead and build a 25 lb. unit. This work was well under way when an opportunity arose for Hamilton Standard to bid on an air conditioning unit for the F-86D. Bid was successful and the way was paved for the company's diversification program and march into the aircraft accessory field.

Currently company is producing air conditioning units and systems for such planes as: F-102; F-104A and B, F-105A, B and C; F11F-1, F8U-1 and -2; and B-58.

New freon refrigeration systems are being designed for Convair's 880 jetliner and Trans World Airlines' Boeing 707's.

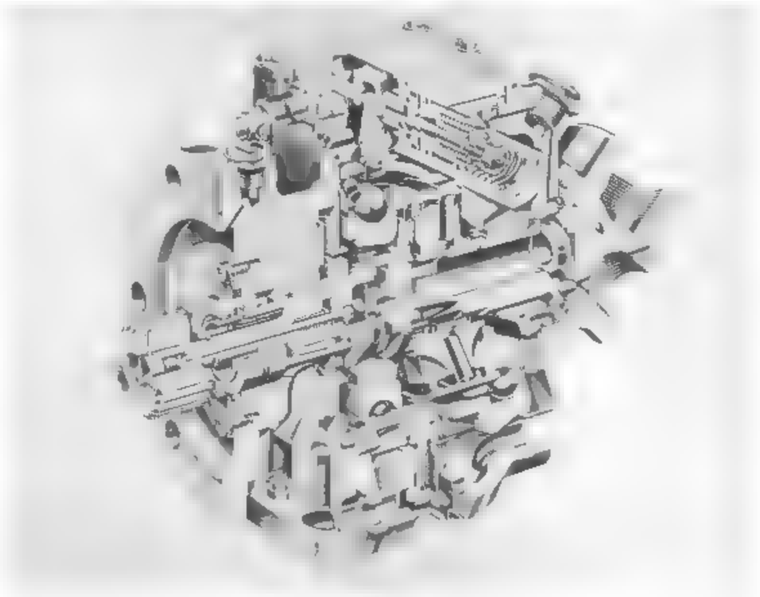
PNEUMATIC STARTERS for gas turbine engines going down assembly line.

Aircooled Bearings

A specially designed feature of Hamilton Standard's air cycle machine is the use of a stream of air to cool high speed bearings and a concept which isolates them from the hot air coming from the fan.

A new air conditioning system feature of one of USAF's latest fighters, Republic's F-105, is a manual cockpit heat control which replaces the usual automatic control system. Reason for reverting to a manual control is that pilots have gotten tired of automatic controls which do not work half the time, AVIATION WEEK was told.

Obvious trend in cooling systems is in increased use of the systems as planes penetrate further into the thermal thicket. First job was to keep the pilot cool. Then avionic black boxes demanded their share of cooling capacity. Now photographic equipment, bomb release equipment and, as on the



CUTAWAY of one of Hamilton Standard's latest hydraulic pumps similar to one used on B-58. Several of the unit's radial pistons can be seen surrounding main center shaft.

Disturbing Missile Trend

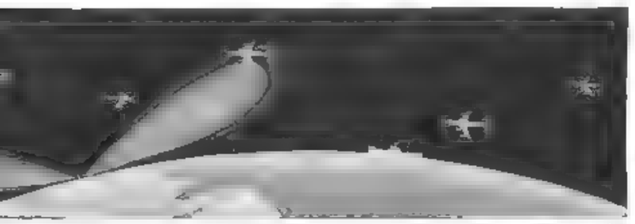
Very disturbing trend in the missile industry for the accessory manufacturer is the inclination of missile weapon system managers to do everything themselves instead of farming out work, according to Erle Martin, Hamilton Standard's general manager. Example of this is that most airframe manufacturers have or are setting up their own electronics departments.

Possible reason is that the state of the art is so new that missile makers have nowhere to turn for their needs, are forced into do-it-yourself projects.

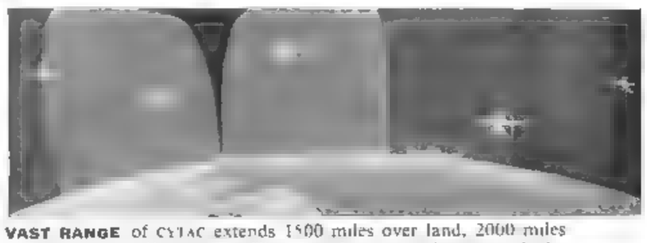
Martin does not think this trend will persist. United States industrial might is built on a host of specialist manufacturers who supply their products to major manufacturers for assembly into the end product. He pointed out that this is one of the fundamental differences between American industry and European industry, which tends to keep all production within the parent organization rather than farm out components not well suited to its type of manufacturing.

As soon as missile needs are clearly defined and known to the equipment manufacturing industry, this do-it-yourself trend will reverse itself, Martin feels. As he put it, "When the missile maker is offered a better mouse-trap than he himself can make, he'll start buying on the outside and stop making his own . . . but in the meantime, we are very concerned about the situation."

CYTAC SIGNALS from widely separated pairs of stations such as A, B and B, C give aircraft or ships their exact location at all times by providing "hyperbolic" lines of position. Position is indicated automatically and continuously for instant reference.



IN CONTRAST to CYTAC, line-of-sight radio signals—similar to television—are limited by earth's curvature. Such signals, therefore, give limited coverage at low altitudes.



VAST RANGE of CYTAC extends 1500 miles over land, 2000 miles over water, at all altitudes. Theoretical range is limited only by power of transmitters sending out signals

CYTAC: SOLUTION TO NATION'S GROWING AIR AND SEA TRAFFIC PROBLEM

Simplified long-range navigation system accurate over land and water

Safe, precise control of our fast-growing air and sea traffic is a top-priority project today. Development of CYTAC now promises to solve the problem.

This unique new Sperry hyperbolic system enables both long and short range aircraft as well as ocean liners to locate their exact position with unprecedented accuracy at all times. Its low-frequency signal reaches 1500 miles over land, 2000 miles over water.

Another key feature of CYTAC is its ability to operate accurately at low altitudes. CYTAC signals simply flow around buildings and other obstacles which block signals from high-frequency line-of-sight systems now in use.

Equally significant is CYTAC's low cost in providing transmitter coverage. To set up a 24-hour, all-weather, air-sea navigation system blanketing the U. S. and adjacent sea lanes requires erection of only 15 transmitters.

This is only one of the developments of Sperry's new Air Armament Division. Other fields of activity include air-to-air and air-to-surface missiles, airborne beacons, countermeasures, fire control radars, inertial systems and bombing-navigation systems.

AIR ARMAMENT DIVISION

SPERRY GYROSCOPE COMPANY
Great Neck, New York

DIVISION OF SPERRY RAND CORPORATION

LOW-FLYING helicopters often find line-of-sight guidance blocked by tall buildings. CYTAC operates even at ground level with high accuracy.

SHIPS AT SEA, even in mid-ocean, can fix position exactly with CYTAC by long-range signals transmitted from shore. CYTAC operates continuously night and day, in all weather.

TRANSCONTINENTAL AIRLINERS now check 30 or 40 radio beacons in crossing U. S.; with CYTAC only 4 station changes would be necessary.

B-58 Hustler, even landing gear tires have to be cooled.

Rapid advances in getting more work out of smaller, more efficient air conditioning machines is underscored by the fact that the freon units designed for the 880 and TWA's 707s weigh but 150 lb., yet have a 10-ton output which can be stretched to 12 tons if necessary. This compares to existing freon machines flying in DC-7s which weigh over 400 lb. and have a 7 ton capacity.

Weight reduction secret is a major engineering effort which went into the design and development of the machine's compressor and the electric motor which drives it.

Fuel Controls

The company branched out into the production of fuel controls some time later. First effort, which was concurred in by certain jet engine manufacturers and the military, was to go into electronic fuel controls. While theoretically a fine idea, the concept failed from a practical viewpoint.

Major problem, which seemed insurmountable with the electronics industry at the state of the art of the time, was how to avoid damage to electronic components in engine fires.

Therefore, with the help of Pratt & Whitney Aircraft, Hamilton Standard turned to the development of hydro-mechanical fuel controls. However, a shift back to electronic controls seems inevitable as soon as reliable components are available because of the inherently greater speed of electronically actuated devices.

The company's fuel controls are now used, either exclusively or as dual source, on such jet powerplants as: P&WA J57 and J75, General Electric's J79 and T58, Avco's T55, Continental's J69 and Fairchild's J83.

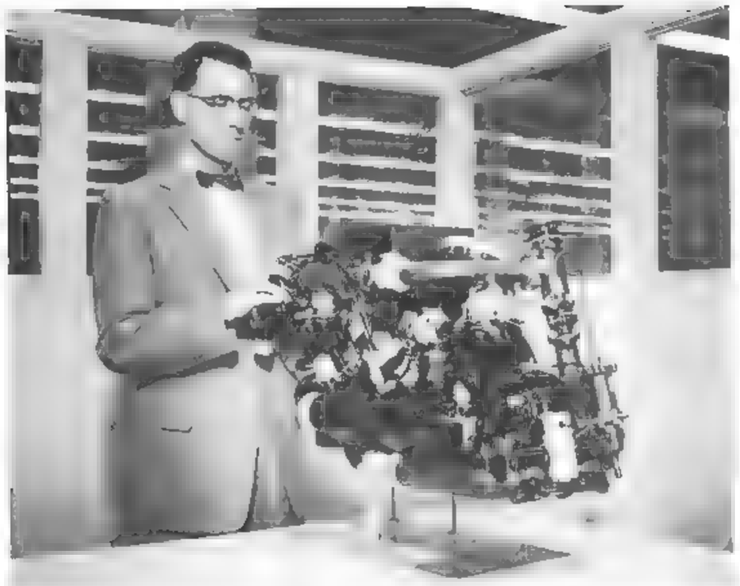
Main aim now is at the smaller 1,500-3,000 lb. thrust jet engine field. Development is progressing on controls for rocket, atomic and unconventional fuels and powerplants.

Company has in limited operation one hot-temperature fuel laboratory where fuels are being tested at 500F inlet temperatures with a relatively small flow capacity. By the end of the year, a second laboratory will be opened with temperature capacities ranging from 600F to [illegible] and flows up to 150,000 lb./hr.

Jet Engine Starters

Hamilton Standard moved into the starter field because it was a natural extension of the background and skills the company had built up in turbines for air conditioning, coupled with the general gearing know-how acquired through its years of propeller experience.

Company produces four types of jet



COMPLEX machine is an air conditioning unit designed especially for supersonic F-104.

engine starters pneumatic, cartridge, propyl nitrate (liquid mono-propellant) and fuel-air

Hamilton got into the pneumatic starter business on the invitation of the Air Force.

Then, because cartridge-type starters, like electrical units, were getting enough too large—they were also creating a logistics problem because they required special cartridges the company's engineers decided to go to the mono-propellant type of starter. To implement this program as rapidly as possible, the company took a license with the English firm Plessey only to run into the logistics problem again; the military did not want to complicate its fuel picture by supplying propyl nitrate at all of its aircraft installations

Fuel-Air Starter

Hamilton Standard then developed the fuel-air starter which is used on the Convair F-102 and the prototype Boeing 707

Same type of starters are being supplied for the Boeing KC-135 aerial tanker and Convair's new F-106

Here is a quick summary of jet engine starter advantages and disadvantages

• **Pneumatic**—Simplest and lightest but, not being self-contained, it requires power from ground cart

• **Fuel-air**—Presents no logistics problem since it uses the aircraft's fuel, but units are relatively heavy and big

• **Mono-propellant**—Smaller and lighter than equivalent fuel-air starter. If built to give two starts, it is also smaller and lighter than cartridge starter; if built for single start cartridge unit has weight and size advantage. Unit is safe at high temperatures. Prime disadvantage is logistics problem it creates by requiring specialized fuel of its own.

• **Cartridge**—Mechanically very simple and reliable, but also creates logistics problem to supply cartridges. They are also explosively dangerous at high temperatures.

Hydraulic Pump Development

When the company continued expanding its diversification program by branching out into the engine-driven hydraulic pump field, it again ran afoul of unforeseen difficulties.

Hamilton Standard heard that the Navy specification for future jet engines would incorporate a high speed drive for which there was no hydraulic pump on the market. At the same time, the company was getting involved in hydraulic pump developments through the Farmingdale Corp. which had made some progress in the relatively unexplored field of high speed, variable displacement rotary piston pumps

Since the time coincidence of the two events made the situation appear quite promising, the company took over the Farmingdale Corp.'s hydraulic pump design and know-how.

Then the military obliterated the company's plans for a bright and profitable pump future based on the high-speed Farmingdale design. USAF did not go to high-speed drives, the Navy changed its mind and the market for high speed pumps—until very recently became non-existent. With no market for high-speed pumps, the company was forced to redesign the pump to make it competitive in the low speed market

High, Low Speed Models

Company has kept development going in both high- and low-speed models. Low speed units are being used on the B-58 and Grumman's F11F-1

B-58 unit is a 300F pump (fluid inlet pressure is 300F). It has an operating life of 560 hr. with the fluid at 300F for ¼ of the total time

Since the high temperature generated by faster planes and hotter engines is the main problem facing the company's engineers, they are in the midst of a program to develop pumps capable of withstanding increasingly high temperatures. They expect to raise the temperature limit in gradual increments 350] 400] 500], beyond which they do not foresee going for the moment.

The radial piston design is quite

Nose-Mounted Prop

New concept called 'nose mounted propeller," is being proposed to the military by Hamilton Standard. The weight-saving idea wraps up in one package a turboprop's propeller, its controls and reduction gearing. Weight saving results from elimination of certain drive shaft bearings which are duplicated in current turboprop designs where the reduction gearing is part of the engine instead of the prop.

Additional weight savings could result from re-designed and lighter prop shaft support structure.

Further advantages of the concept—which visualizes bolting the nose-mounted prop directly to the nose of the engine—is that engine builders can design a powerplant to turn at whatever speeds will give optimum performance and supply it with merely a stub drive shaft which would be coupled to the nose-mounted prop. Prop's reduction gearing and controls would have been specially tailored to the engine's rpm., horsepower and other operating considerations. The idea gives engine manufacturers much greater design freedom than they now have.

Nose-mounted prop concept could save about 90 lb. if incorporated on General Electric's T64, 2,600 hp. aircraft-helicopter powerplant (AW Sept. 30, p. 34), propeller engineers estimate

One of Hamilton Standard's first nose-mounted designs was for the now-canceled Douglas C-132 giant turboprop-powered transport. Specifications for this propeller were: diameter, 20 ft., maximum blade chord, 22 in.; length, 5½ ft.; weight, 3,600 lb.

Company engineers say they are now examining the nose-mounted concept for much smaller turboprop engines.

different from the more familiar axial piston concept of Vickers and New York Air Brake. Its efficiencies 85% at 250I and 83% at 360I are perhaps lower than axial piston types, but the efficiency loss curve with rising temperatures is considerably shallower, according to Ham Standard.

A major design effort is going into eliminating as many pump seals as possible, since seals are a real problem at elevated temperatures. One approach is to consolidate components as much as possible; example is a new pump housing which was redesigned from three pieces to a single unit.

A new hydraulic pump development now in the company's laboratories is a metal-to-metal dynamic seal for the pump's servo pressure control piston. Seal resembles a double automobile piston ring.

Propeller Future

Many developments point to propellers having a long and useful future in the jet age, provided the designs for which they are used remain in the subsonic up to Mach .94 range. Company propeller experts concede that new aircraft designs seem to steer clear of supersonic props.

The many types of aircraft which Ham Standard is looking to for a long and continuous propeller market include:

VTOL, STOL, medium to big to very big transports such as the successful Lockheed C-130, the underpowered Douglas C-133, which may gain a new lease on life with the installation of more powerful turboprop engines, and the currently canceled mammoth Douglas C-132.

If the much talked about nuclear-powered WS-125A ever takes shape—and if it is to be a high subsonic plane—turboprops would provide the most efficient conversion of energy to thrust, according to HS engineers.

Navy Requirements

Several military requirements for propeller-driven planes, both turboprop and piston engine, are in the offing. Navy has requirements for both land- and sea-based two-and four-engine craft for Aircraft Early Warning and Anti-Submarine Warning duty.

Another category of aircraft which Ham Standard thinks will be propeller-driven for a long time to come is the light plane—the L-19 and L-20, the Beaver and Otter. Replacements for these piston engine planes will almost certainly be turboprop powered, HS thinks.

Big enigma to the propeller market is Military Air Transport Command. The service has shown little interest in replacement aircraft for its aging fleet of C-118s (DC-6 type) and C-121s (Constellation type) transport planes.

Still another indication that propellers have a bright and lusty future is the fact that several large airframe manufacturers have propeller powered planes in the various stages of cutting metal, on the drawing boards or in preliminary design. Among such companies Ham Standard officials cited Grumman, Convair and Boeing.

Shrouded Props

A well-known but neglected design feature which merits more attention than it has been getting is the shrouded prop. By wrapping a shroud around a propeller, thrust increases of 50-75% can be obtained at low speeds—during hovering for VTOLs, for example. Excellent maneuverability at zero or low speeds can be obtained by placing movable vanes in the prop discharge blast.

The faster a plane goes, however, the greater a liability the shroud becomes. Ham Standard studies indicate that if a shroud is wrapped around the prop of an existing airplane design, it would switch from an asset to a liability at about 150 mph. because of its added weight and drag. However, if a plane were designed to include a shroud, and considerations were given to the added lift it produces coupled with the reduction in wing drag resulting from shortened wing span this added lift would allow, speed at which the shroud becomes a liability jumps from 150 mph. to about 300 mph.

"Turboprops can surpass turbojets as thrust-producing machines at all subsonic speeds up to Mach .94 about 600 mph. at 40,000 ft., a Ham Standard engineer stated.

Theoretically at least, the U. S.'s first

Navy T2V-1 Reports for Carrier Duty

Navy's Lockheed T2V-1 SeaStar landing aboard the USS Antietam for its first sea duty. New ship-or-shore duty trainer recently completed primary carrier suitability tests during operations held off the East Coast. Arresting hook contains pitot tube for air speed reading, and dual-purpose antenna for pilot's UHF command radio and for plane's Tacan unit. Antenna is 8 in. long, 5 in. wide, 1½ in. thick. Pitot tube is 3⅞ in. long. SeaStar is in quantity production at Lockheed's California division. In consolidating radio and Tacan antennas, LAC technicians developed a two-channel filter to isolate equipment operating in different frequency ranges.

crop of jet-powered passenger planes 707, DC-8, 88 would have been more efficient had they been powered by turboprops instead of turbojets, propeller engineers told AVIATION WEEK. Reason is that when converting energy into thrust, propellers produce efficiencies of about 80% and current engines only about 60% at speeds of 600 mph, the approximate speed of the three upcoming jet transports.

One basis for jet designers going to turbojets was that no turboprop power plants of the desired size were available when the aircrafts' plans were first laid down.

Penalizing Factors

As plane speeds exceed 600 mph, turboprops become increasingly unattractive powerplants. Factors which penalize propeller engine combinations as compared to pure jets at high speeds include increasing mechanical complexity, weight, maintenance and compromise in aircraft design to locate the engine so that the prop will have adequate ground clearance.

Hamilton Standard's diversification program and resultant plunge into the aircraft accessory field has not been without its problems and potential penalties. As the company proceeds on its course of making non-propeller items, some of the potential dangers have begun to materialize.

Martin put the problem this diversification program has created this way: "As we go forward, departmental specialization on a product basis is required because of the variety of products we ship each month. This specialization reaches down into sales, purchasing and many other phases of our overall operation.

"It appears that there will be a tendency to increase this product specialization to the point where virtually autonomous departments are set up by product. The fuel control with its own building and the electronics department, are examples of this trend.

Individual May Suffer

"Disadvantages, of course, and this is one item that disturbs us particularly, are the possibility that this product specialization will threaten the opportunities available to our people as a result of this growth. Selection of the right people for the job regardless of departmental function or length of service, is the only way to recognize individual abilities. These abilities, in the final analysis, are the cornerstones on which the ultimate success of a business must rest, and specialization will have a tendency to limit those abilities to one narrow product line. For this reason we are following a policy of departmentalization by product no more than absolutely necessary."

Nitrogen Tested as Tank Inerter

Method of inerting aircraft fuel tanks to prevent fires from lightning strikes or enemy action will be tested shortly in England in a specially-modified Canberra jet bomber.

System, developed by British Oxygen Aero Equipment Ltd., introduces nitrogen into the air bled from the jet's compressor to pressurize the fuel tanks. Proportion of nitrogen is properly regulated to assure an inert gas within the tanks as fuel level drops.

Falling back on its experience in developing small, lightweight liquid oxygen breathing systems (AW July 29, p. 85), company evolved a liquid nitrogen system to keep nitrogen supply as small and light as possible. System weight is 15 lb. per 1,000 Imp. gallons (1,201 U.S. gal.) of fuel.

Nitrogen is carried in a small converter in liquid form and piped to a swirl atomizer where it is mixed with the tank pressurizing air. Heat of air vaporizes the nitrogen so that an air-nitrogen mixture enters the fuel tanks.

Correct proportions are maintained by a ductstat control.

Republic Titanium Flies with Convair's B-58 Hustler

The B-58 is built for the Air Force by Convair, A Division of General Dynamics Corporation, Fort Worth, Texas. Powered by four General Electric J-79 engines, the plane is designed to operate at altitudes above 50,000 feet. Photo at left is one of the first showing detachable pod under fuselage. This feature permits performance of a greater variety of missions.

Republic titanium alloys used for elevated temperature applications and weight saving in America's first Supersonic Bomber

The delta-winged B-58's transformation from drawing board to production in record-breaking time is a tribute to the design-and-engineering skill of Convair Division, General Dynamics Corporation.

This dream plane incorporates the most advanced equipment and utilizes the latest engineering materials, including Republic Titanium.

Titanium alloy types produced by Republic Steel are used in the B-58 for weight saving and elevated temperature applications. These particular titanium alloys are among the strongest now being produced. They offer high strength values at elevated temperatures.

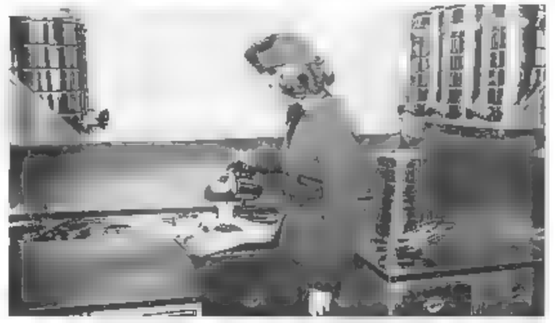
These alloy types have a minimum tensile strength of 130,000 p.s.i. and a minimum yield strength of 120,000 p.s.i. They meet the demand for high strength to resist the effects of aerodynamic heating in supersonic aircraft, such as the B-58.

The Hustler is the world's fastest bomber. What about the future? Right now, planes are being designed for speeds of Mach 3 or 4. Republic is keeping pace. At the Titanium Research Laboratory in Canton, Ohio, new titanium alloys are being developed with better physicals to provide greater operating efficiencies.

In exploring the "thermal thicket", many materials must be appraised and utilized. Republic—world's largest producer of aircraft steels—is working on new high-tensile, stainless types with higher strength and greater heat-resistance.

Republic metallurgists and engineers pioneered the development of high strength-to-weight metals. They offer you years of experience gained through helping hundreds of manufacturers design and redesign their products to get more strength with less weight at less cost. Contact your local Republic sales office for more information. Or send us the coupon.

WEDGE-LOCK STEEL SHELVING ADJUSTS QUICKLY and easily to stock changes at Sikorsky Aircraft Company. Parts move out of storage and into production fast at the company's Bridgeport, Connecticut, plant. Wedge-Lock permits a systematic arrangement of stock for immediate identification. When inventory changes occur, shelves are quickly and easily rearranged. Wedge-Lock Steel Shelving is specifically designed for high stacking of enormous weights. There is no distortion or instability. Republic's storage engineering service is available without obligation. Mail coupon for facts.



ENDURO STAINLESS STEEL IS MADE FOR FLIGHT in both military and civilian aircraft. Above, it is used in an airliner galley for food-serving equipment. ENDURO is easy to clean and keep clean. Resists rust and corrosion. Will not chip, crack, flake, peel or tarnish in tough service. ENDURO offers the designer engineer numerous benefits in the form of high strength-to-weight ratio, toughness, heat-resistance, corrosion-resistance. ENDURO is the aircraft metal of many uses, from galley to cockpit, from power plant to skin. Republic will help you apply it to advantage.

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WHAT'S NEW

Reports Available:

The following reports were sponsored by the Office of Technical Services, United States Department of Commerce, Washington 25, D. C.

Injection and Combustion of Liquid Fuels—by A. A. Putnam and others, Battelle Memorial Institute for Wright Air Development Center, U. S. Air Force; $9.00; 786 pp., (PB 131008).

Spark Ignition of Fuel Mists—Development of Apparatus and Preliminary Results—by A. E. Weller, Battelle Memorial Institute for Wright Air Development Center, U. S. Air Force Dec. 1956. $1.00; 31 pp.; (PB 121855).

Hydraulic Research in the United States—Helen K. Middleton, Pub. by National Bureau of Standards, United States Department of Commerce, Washington 25, D. C.; $1.50; 220 pp.

The Cook Technical Review, Volume 4—Number 1—Pub. by Cook Electric Company, 2700 Southport Ave., Chicago 14, Ill.; $1.25; 13 pp.

How To Select an Air Compressor of the Right Size and Type—Pub. by Air Compressor Research Council, 27 East Monroe, Chicago 3, Ill., $.50; 11 pp.

OFF THE LINE

New, room-temperature vulcanizing silicone rubber, recommended for encapsulating electrical and electronic parts and for general potting, sealing and caulking applications, is available from Dow Corning Corp. Called Silastic RTV 501, the rubber is mechanically or manually mixed with Silastic Catalyst A before application. Vulcanization takes place within 24 hr at room temperature. Curing can be accelerated by use of 200F heat

Millville, N. J.—Some problems of flying high speed jet aircraft under current Instrument Flight Rules, gleaned from personal experience, were discussed at the recent Airwork Operations Symposium by Dr. Ralph Queal of the Aero Medical Laboratory, Wright Air Development Center. Among them

- Being given an IFR flight plan which required him to make a right turn that was tighter than his F-80 could possibly negotiate
- Departing Washington, D. C., on an IFR flight plan, again in an F-80, he contacted Air Traffic Control over his

first check point. He was told [illegible] his current heading. When he was finally cleared to destination, he was 100 mi. away, over Charlottesville, Va. His destination was Mitchell Al B, N. Y., whose heading was almost in the [illegible] direction.

Airwork's expansion [illegible] develop[illegible] [illegible] the [illegible]:

- **New building** just completed adjacent to the Atlanta, Ga., airport
- **New facility** near the Cleveland, O., airport will be ready for business by Jan. 1, 1958
- **New shop** building now underway at Miami, Fla.
- **Company's entrance** into the instrument overhaul field through its Atlanta and Miami shops
- **Expansion of service** coverage through its branch offices, field representatives and [illegible] organization

New and popular [illegible] to the Airwork Operations Symposium was a large discussion tent. In it, 22 equip[illegible] manufacturers and suppliers set up booths manned by company engineering [illegible] and technical representatives. There, airplane owners, operators and pilots could, and did, sit down and discuss any problems they had face-to-face with the manufacturer of [illegible] product. Idea [illegible] proved to be a good sales technique. One manufacturer, because of this opportunity to demonstrate his equipment on the spot, [illegible] reportedly sold over $300,000 worth of radio and navigational gear to General Motors for its fleet of corporate aircraft.

New 500-gal. liquid oxygen transporter has been put on the market by Hoffman Laboratories. A line of the units are being built in sizes up to 2,500 gal. Transporter features a new type undercarriage with a self-contained

hydraulic unit for quick and easy loading and unloading of LOX. The container [illegible] insulation, quick pressure build-up system and company-developed quick disconnect couplings. Address: 219 Emmet Street, Newark, N. J.

New oxygen cylinder valve has been developed by Robbins Aviation to eliminate unsatisfactory operation of such units which may result in potential fire hazards. New unit, which measures about 2 in. in diameter and 4½ in. long, is designed to avoid instantaneous pressure surges downstream of the valve, even when it is manually opened at maximum rate. Valve opens smoothly without undue cracking torque. Unit incorporates a frangible, disc-type safety outlet and a gage to register continuously cylinder pressure.

Buffets on United Air Lines' fleet of Douglas DC-8 jet transports will be furnished by Weber Aircraft Corp., Burbank, Calif.

Separate Service [illegible] and Repair Department has been established by Hamilton Standard division, United Aircraft Corp. New department puts the company in a better position to accept military and commercial overhaul and repair contracts, especially for its own propeller and non-propeller products. Manager is S. B. Sherwin.

Robertshaw-Fulton Controls Co. has formed a seal sales division to handle the company's high temperature metallic seals used in aircraft, missiles and nuclear installations. W. M. Watkins, Jr., will head up the new organization from headquarters at the Fulton Sylphon division, Knoxville, Tenn.

DENVER BUSINESSMEN and everyday citizens were impressed by luxurious interiors of executive planes. Shown for the first time to public were new Beech Model 95 Travel Air light twin (right) and single-engine four-place Piper PA-24 Comanche (behind Travel Air).

NBAA Plans Basic Operational Manual

By Erwin J. Bulban

Denver—Manual aimed at providing safety and operational guidelines for corporate aviation departments and top management is receiving high priority from National Business Aircraft Assn.

Association is attempting to whip into shape a draft of its proposed manual prior to dissemination among its membership for comment before publication. Basic points of the draft were debated here during NBAA's annual meeting in an attempt to get a cross-section of pilot opinion on its current points.

Primarily a Guide

Association admits that writing such a manual is a thorny task, considering the widespread viewpoints of its some 400 members who operate the most diversified air fleet in the world. Toughest job is educating the pilots that it is not proposing a "Bible" to which corporation pilots must adhere, instead essentially a floor of minimums that it considers necessary for safe operations. It also acknowledges that many of its members already have satisfactory manuals incorporating standards much higher than those proposed and that its effort is not planned to supplant these. It understands also that it could not possibly develop a manual that would be suitable on all counts to even a portion of operators of business aircraft.

Reasons for Project

Why then bother?

Primarily for these very necessary reasons, NBAA notes:

- **Business flying** must go on record in establishing self-regulation of its operations under standards with which it can live and continue to flourish to avoid vacuum which Civil Aeronautics Administration and Civil Aeronautics Board may feel is untenable, safety-wise.
- **Establish close liaison** with its "customers," corporate management, so that safety and operations objectives will not be compromised.
- **Provide assistance** to numerous new corporations purchasing business aircraft who need assistance in setting up their operation and lack "primer" type information of type NBAA manual would provide.

Business flying has been enjoying an atmosphere comparatively free of government regulation, in strong contrast to the airlines. Civil Aeronautics Board and Civil Aeronautics Administration have become increasingly aware of the impact of this rapidly growing private transportation fleet upon U. S. aviation facilities and in some quarters there has been growing feeling that business fliers should conform to many of the same regulations as govern the scheduled carriers.

Phenomenal Growth

Speaking before NBAA members here, CAA Administrator James T. Pyle took cognizance of this "phenomenal growth," noting that in 1954 there were 13,600 planes, engaged primarily in business flying employing some 3,500 professional pilots, and that by 1956 this had increased to 23,000 aircraft employing more than 5,000 professional

AERO DESIGN all-gold Super Commander, 500th built, made a late appearance at NBAA display, captured a commanding position on Broadway, downtown Denver

TRECKER SUPER GULL amphibian was appropriately displayed in fountained aquarium of Denver's Mile High Center. Airplanes were towed intact to display from Stapleton Airfield.

SMALLEST PLANE SHOWN was Forney Aircoupe two placer, a modernized postwar version of prewar Execoupe. Priced at $6,250, 40 Aircoupes have been delivered.

[illegible] Approximately half of [illegible] transport certificates [illegible] in general aviation and most of them are in business flying, he stated.

Particularly noteworthy, he remarked was the fact that from January 1956 to January 1957 the number of multi-engine airplanes in general aviation increased by an astonishing 25%.

New Problems

Pyle stated that CAA and business flyers must jointly solve new problems of safety brought on by all of these developments and changes and new equipment.

It is obvious that if business flying does not work on the problems, CAA will feel that it will have to do it unilaterally.

NBAA feels that across-the-board regulations could well restrict many business aircraft operations, discourage prospective users from entering the field.

For example, fatigue factor has been considered by CAB, at a meeting with NBAA it has proposed that business pilots stick to airline standards, which normally restrict pilots to eight hours flying in a 24-hr. period except on transcontinental nonstop flights which provide a limit of 10 hr.

Checking CAB accident files, NBAA found that there had been no business aircraft accidents attributable to fatigue since 1945, indicating that fatigue is not as critical a factor as CAB had thought.

But this was one of the points proposed for the manual. Suggested was 30 flying hours a week, 75 hr. a month and not more than 800 hr. a year. One company pilot stated that his company works on a mileage rather than hour basis; its rule is that pilots can fly up to 2,000 mi. in two consecutive days, must lay off the third day.

Pilot Authority

One point on which there was [illegible] concurrence was that the chief pilot should be delegated complete authority on operation of the aviation department from the chief executive of the company. This would mean that if there were any questions or dissatisfaction with loading of the airplane from within the company, these would have to be referred in writing to the chief executive, freeing the pilot as a point of dissension.

Pilot duties in the cabin and when not flying also are touched on. NBAA guide states that the pilot should not be expected to perform cabin duties in heavy traffic areas or if they keep him out of the cockpit more than a few minutes at a time.

One company pilot noted that his operation had reached an understanding with executives that food was

Business Flyer Awards

Denver—Safety awards have been made to 131 corporation pilots who have flown a total of 115,853,845 mi. without a dent to their aircraft or injury to a single passenger.

National Business Aircraft Assn. presented awards to 43 pilots who have flown one million miles or more without accident or injury and to 88 others who have flown more than 500,000 mi. with the same record.

In addition NBAA honored 42 member corporations who have compiled a total of 79,716,630 mi. without accident or injury. Awards are based on standards set by American Standards Assn. and by National Safety Council. Last year 29 pilots received one-million-mile safety awards, 59 were given 500,000-mi. honors and 26 corporations received company awards.

brought aboard and available on a help-yourself basis; in fact the passengers also served the crew.

There was difference of opinion as to whether pilots should perform other company duties in addition to their flying tasks.

Some pilots feel that this could prevent them from keeping proficient or would impose a fatigue factor on them. Others felt that pilots should be free to take on another job which would provide them with the training needed so that they could be absorbed into the company when they could no longer pass their flight physical. Past NBAA president Henry Boggess, Sinclair Refining Co., Tulsa, noted that his firm's policy was to retire pilots at the age of 50 and provide them with another job in the company.

Still another company representative said that his firm's policy was to have pilots interviewed by firm's personnel department regarding another career in the company and then help the pilot study to prepare him for a position for which he would be suited.

NBAA hopes that dissemination of such a manual will provide company pilots with a means of showing their chief executives reasonable limitations that must be observed if safe operation is to be maintained. Fact that guide was prepared by a cross-section of the country's top executive pilots, it is felt, will carry some weight in getting this message across to the non-aviation executive.

Lightplane Avionics Dealers Form Group

Denver—Avionic equipment dealers concerned primarily with business flying market have formed Aircraft Electronics Assn. which hopes to solve some of the knotty problems of dealer-manufacturer relationships, work out a code of ethics of service and attempt to develop a set of minimum standards for shops.

Charles Peacock, Aircraft Radio Accessory Co., president of the new association, told AVIATION WEEK that the association also hopes that by frequent meetings, dealers will be able to interchange considerable valuable information learned from in-the-field contact with customers that will benefit manufacturers in designing new products having more utility, better service life and easier maintenance. Cross-pollination of ideas among dealers also should help spread of most efficient practices through shops in making installations.

Another prime goal is to develop closer liaison with Civil Aeronautics Administration on supplemental approvals of equipment installations. Currently, because of lack of sufficient CAA personnel, process is often time consuming and aircraft are grounded from one to 15 weeks before approval is granted.

New association hopes that process can be streamlined.

Association had its first meeting in September in Minneapolis. The dealers expect to have another in Dallas in March.

Import Planned of Spanish Business Plane

New York—Spanish built light transports, re-engineered to meet U.S. business flying requirements, will be imported to the U.S. next year, Aviation Week has learned. Now being groomed to Civil Aeronautics Administration Part 04B regulations, new plane will be a 250-mph.-cruise executive transport seating about a dozen passengers and costing approximately $275,000 ready to operate.

Transport is an executive version of the Spanish CASA 202 Halcon designated the 202B. Basic configuration is low-wing, twin-engine, tricycle landing gear. Cabin is unpressurized. First prototype has been flying since 1952; second prototype, with more powerful engines, has been flying since 1956. Plane was designed to comply with both British and U.S. airworthiness requirements.

Minnesota Airmotive has taken on North and South American distributorship for the new airplane and has some 20 on order, on condition that it meets CAA Part 04B specifications. It expects to fly the first airplane to the United States via the North Atlantic in April or May, then send it on a nationwide demonstration tour. Several executive plane owners have expressed firm interest in purchasing 202Bs, Aviation Week understands.

Minnesota Airmotive, Inc., Wold Chamberlain Field, Minneapolis, first became acquainted with the Halcon when it was purchasing approximately a dozen Lodestars in Spain for conversion to executive planes. Initial evaluation indicated that, with some modification to meet U.S. executive requirements, the Halcon would have a promising market.

Minnesota Airmotive has approximately a score of its modification specialists working with the Spanish manufacturer on this program. In addition to general aerodynamic cleanup, the 202B will be completely fitted with American-made equipment and accessories, including new landing gear incorporating Goodrich single-disk wheels and brakes and high-pressure Type 21 pneumatic boot type de-icing system. Power packages will be Wright R1820-56As furnished by Steward-Davis having Stamesed exhaust stacks fitted with augmentor tubes. New NESA electrically de-iced windshield, designed to transport requirements, will be fitted. Plane will have a built-in Airstair-type passenger door.

Preliminary engineering analysis indicates that the executive 202B will have gross weight of about 22,250 lb., landing weight of 18,750 lb. weigh 13,800 lb empty. Wingspan is approximately 65 ft., length 52 ft. Maximum inside cabin diameter is about 6 ft. Power to weight ratio will be approximately 8.84.

Indicated performance (at maximum gross weight) from preliminary data: cruise speed of 245.4 mph. at 65% power; sea level rate of climb, 1,555 fpm., climb at 3,000 ft., 1,536 fpm at 10,000 ft., 1,055 fpm. Single-engine service ceiling will be approximately 9,700 ft. Normal range is estimated at 1,691 mi. Halcon 202B will take off in about 2,100 ft. over a 50-ft. obstacle at zero wind, no flaps; with one engine out, takeoff will take 4,700 ft. It will require 2,694 ft. for landing.

Price of $275,000 will include full interior, instrumentation and communications and navigation gear to customer's order, excepting radar and radome.

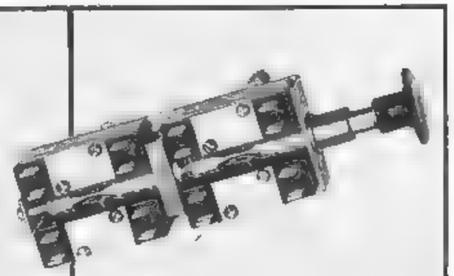
Cost a problem in designing your controls?

consider this:

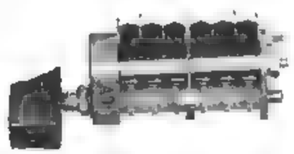
These PROVED-IN-USE ELECTRO-SNAP assemblies are now STANDARD production items!

MODEL A9-6—Rotary release switch, 2-position DPDT, simultaneous action. Vibration resistant, binder screw termination.
Dimensions 1¼" x ¼" x3⁹⁄₁₆"

MODEL C3-8—Vibration-free, positive detent-action, cut-off switch with potted wire leads in DPDT with simultaneous action. Dimensions 1⅞" x3⅝₆" x1⅜"



MODEL C3-13 High current, manually-operated cut-off switch. Will simultaneously interrupt 4 circuits of 40 amps, 30 V DC — or much higher voltages with lower amperages. Has 8 separate circuits available in one control device. Dimensions. 5¹³⁄₁₆"x1½"x1½"



MODEL A9-7 — Multi-pole, ganged, sub-miniature assemby with rotary actuation. Positive detent-action gives exact indexing for accurate control
Dimensions. 3⁷⁄₃₂"x1⅛"x²⁹⁄₃₂"

MODEL A4-67 Manual pushbutton actuated, 2 to 6 circuits single pole to triple pole, simultaneous action. Available with various colored buttons.

MODEL HS25-4 Hermetically-sealed, rocket safety switch, highly vibration resistant. Roller actuated, SPDT, 1 circuit, 4 amps @ 30 V DC, res.; 2.5 amps., ind.
Dimensions 3⁵⁄₃₂" x1"x1".

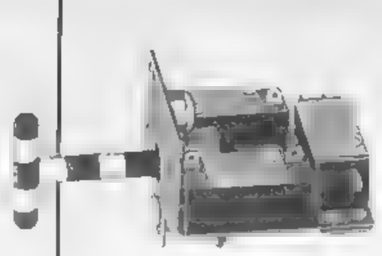
● Over the years, ELECTRO-SNAP has developed literally thousands of special switches which are now available as standard production models.

Most important—one of them may be *exactly right* for your needs. And that will mean *standard switch* economy for you . . . plus *proved* precision, performance, stability and operational long-life!

Why not investigate the huge selection of precision-engineered ELECTRO-SNAP standard switches and control assemblies? Describe the particular application you have in mind, together with complete specifications — and we will promptly forward you our recommendations and full technical data.

MODEL H1-43—Stepless adjustment, roller-arm actuated, DPDT 4 circuit limit switch. Ribbed case hermetically sealed against heat and cold. Highly shock resistant. 10 amps @ 125/250 V AC, 30 V. DC. Life 200,000 ops. Dimensions. 1¼" x 3¾"x1⁷⁄₃₂" (Also available DPDT.)

MODEL A2-11 Hermetically-sealed roller lever actuated switch. Rubber booted terminal board base with screw terminals. Corrosion resistant. DPDT 4 circuits, 15 amps at 120 V AC, 30 V DC. Dimensions 2¹³⁄₁₆" x3¼"x¹³⁄₁₆



MODEL C3-11 Mechanical over-ride assembly. Will convert from automatic function to manual operation of control surfaces.
Dimensions 3¼"x1¾" x ½"

MODEL C1-4 Hermetically-sealed, multi-pole assembly. Automatically actuated with manual over-ride for powering and de-powering multiple circuits.

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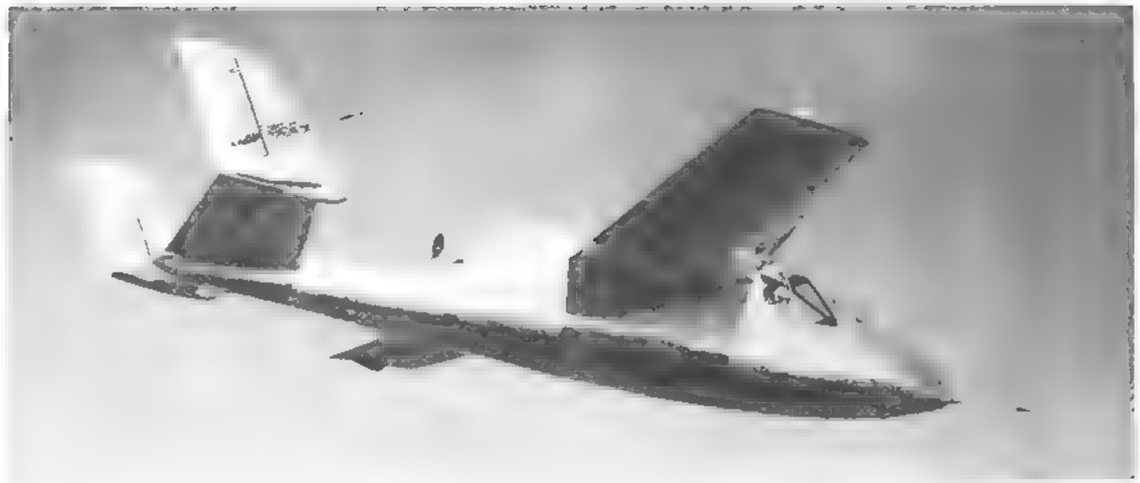
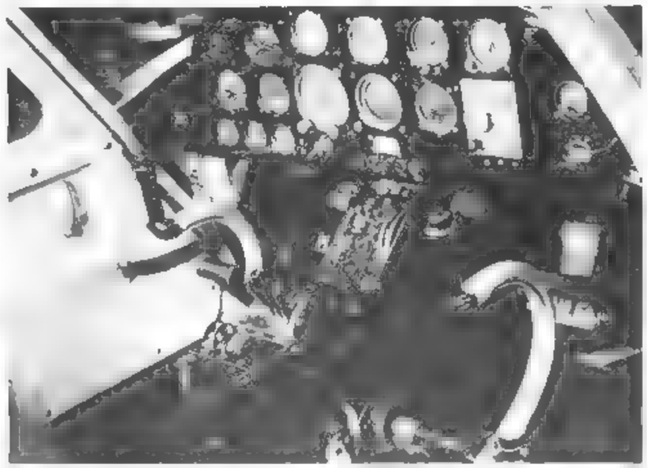


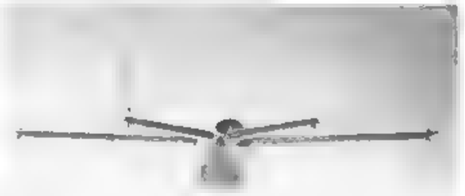
ALL-ROUND VISIBILITY is provided by positioning wing high behind cabin and placement of engine atop fuselage. Turbomeca Marbore 2 of 880-lb. thrust gives 260-mph. cruise speed at 10,000 ft. Later, more powerful jets would raise cruise speed to 382 mph.

Miles Jet Trainer Starts Flight Trials



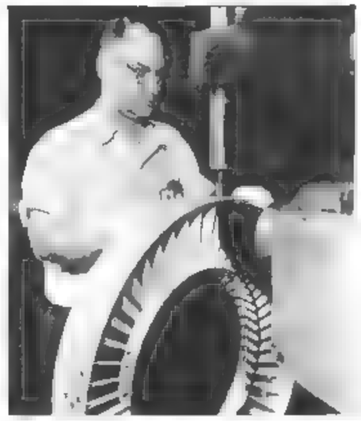
SIDE-BY-SIDE SEATING puts instructor close to student to speed training.

FLUSH INTAKE (atop cockpit) is close to readily accessible Marbore.



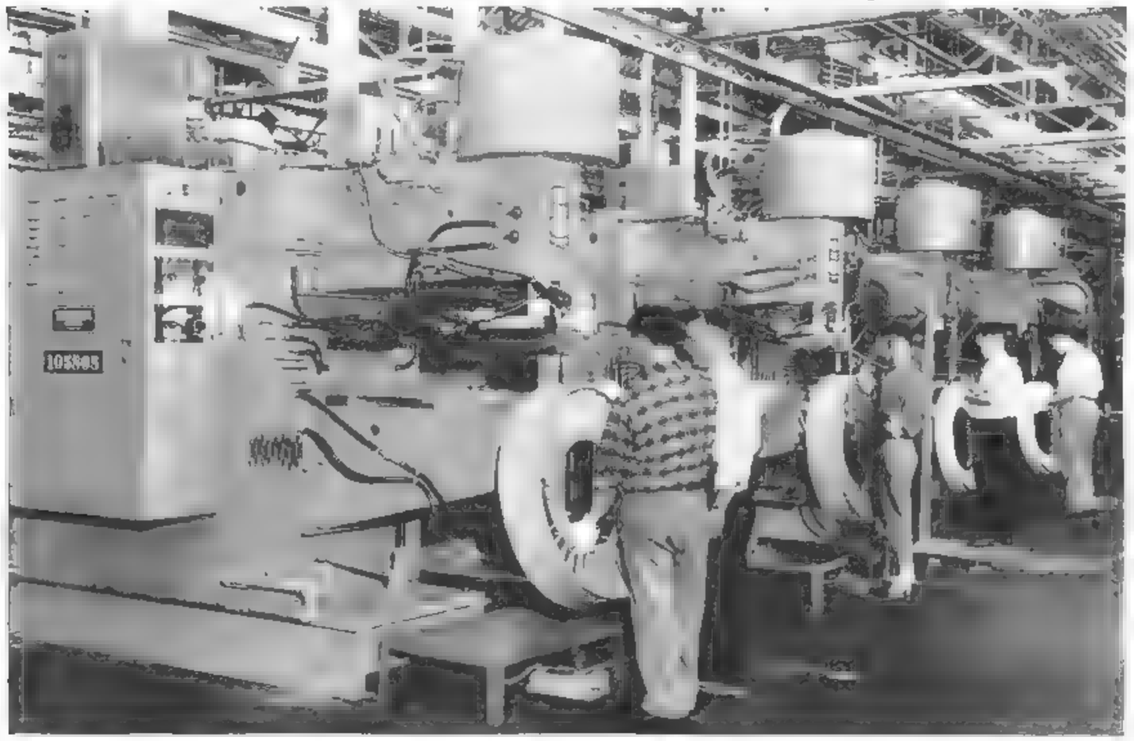
TWIN TAIL has single spar for bending, torsion loads.

DIVE BRAKE juts out above landing gear.



Close-up of the shroud stator being resistance welded.

Four Sciaky patented Three-Phase welders installed in the East Hartford plant of Pratt & Whitney Aircraft. Since the photo was taken, a fifth machine has been added. They are the only welders capable of welding aluminum shrouds without leaving cracks.



East German, New Zealand Spraying Contrasted

Contrast in agricultural aviation activities on both sides of the Iron Curtain is shown in projects being carried out in East Germany and New Zealand.

Like Soviet airline Aeroflot, Communist controlled East German carrier, Deutsche Lufthansa, controls agricultural aviation. Russian Antonov AN-2 single-engine biplane (top) is loaded with dust chemical by means of a hopper opening atop the fuselage. Soviets say AN-2 takes 1,300-1,500 lb. of dry chemical. AN-2 is dispensing its load at tree-top height over insect-infested forests around Arnstadt, Stadtilm and Ilmenau (right).

Auster Agricola spray plane (below) is dispensing liquid chemicals at up to 40 gal./acre in New Zealand. Though much smaller than the AN-2, the Agricola can carry up to 1,680 lb. of dry chemicals or 177 gal. of liquid.

Cessna 620 Passes Phase I Flight Tests

Wichita—Four-engined pressurized Cessna 620 business transport recently completed its Phase I test program for Civil Aeronautics Administration involving performance and flight characteristics. The 620's new Continental GSO526 single-speed supercharged flat engines are in their final stages of certification.

Cessna has not yet officially disclosed a backlog for the 620, but it is known to consist of at least one customer. Actual production line is expected to be set up in the next 90 days in Cessna's new Wallace plant and the first 620 production model is expected to leave the factory in late March.

Company's flight test program showed that slight reduction in takeoff and METO power could be traded for additional cruise performance, according to designer Ralph Harmon. As a result, engines are officially rated at 340 hp. at 3,100 rpm. at takeoff and at 300 hp. at 3,000 rpm. for maximum continuous performance.

Number two prototype is undergoing extensive full-scale static trials involving 20 major tests. This will include ultimate load conditions of 100,000 lb. uploads and 100,000 lb. downloads.

PRIVATE LINES

U. S. export of civil planes weighing 6,000 lb. or less in the first eight months of 1957 totaled 822 aircraft valued at $12,631,580 compared with 596 units valued at $7,476,103 for the same period last year.

Single pilot, using a Bell 47G-2 helicopter, [illegible] lbs. of mixed plus personnel in one month in Canada, logging 130 hr. of flying with 1,040 takeoffs and landings. Flights were made from a lake to 7,000-ft. level of three adjacent mountains six miles from base camp, averaging slightly over 500 lb. on each trip. Pacific Western Airlines helicopter pilot William McCarthy set the record despite having better than two weeks of adverse weather during the feat.

Cloud seeding by aircraft has raised annual rainfall over 1,500 sq. mi. of Southern Table Lands, New South Wales, Australia, by more than 25% over a three year period.

Safe Flight Instrument Corp., N. Y., appointed Don Horn Co., Memphis, Tenn., and Alaskan Aircraft Equipment Supply, Inc., Anchorage, as distributors.

Cessna 310 will be used by Spartan Air Services, Ltd., on two air photo mapping contracts covering the whole of Trinidad (about 1,900 sq. mi.) and up to 2,000 sq. mi. of British Guiana. Cessna will be fitted with a Swiss Wild RC-8 camera.

Follow-on contract, totaling $10.6 million, for 1,700-gal. jettisonable fuel tanks for B-47s has been awarded Beech Aircraft Corp. by Air Materiel Command. New award extends Beech tank work into mid-1959.

Holliston Mills Co., Norwood, Mass., acquired a Remmert-Werner converted Douglas Super-92 DC-3 seating 14 passengers. Equipment includes Collins 17L VHF transmitter, dual Collins 51R VHF omni, Collins 51V UHF glide slope, flush type Bendix ADF loops and retractable tail wheel.

WNEM-TV, Channel 5, has located its executive and sales offices and a television studio on the second floor of Bishop Airport terminal, Flint, Mich., to expedite travel of executives who use company's Aero Commander.

Additional 800 man-hours annually will be gained for key personnel through charter of Bell Ranger helicopter at a

Avro Aircraft Limited has achieved a brilliant record, creating the famed Jetliner, the rocket-firing CF-100 and soon now, the supersonic Avro Arrow. Still shrouded in secrecy, advanced aeronautical projects now in the design stage, present new challenges to men with imagination and vision who have a sound background in engineering, mathematics, physics, aerodynamics, metallurgy or computer programming.

startling things are happening in CANADA at AVRO

Enthusiasm and excitement keynote all aspects of design and engineering at Avro. For Avro Aircraft's advanced projects are pushing into the thermal thicket . . . rising into the stratosphere. There new mysteries remain to be solved; new challenges loom for men with skill and ingenuity.

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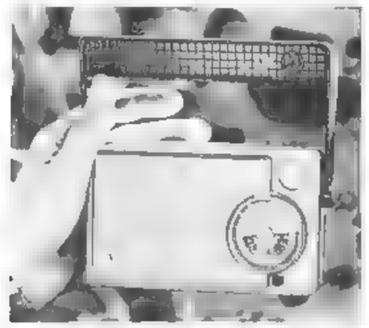
minimum of 25 hr. monthly, estimates chief executive of Murray Corp., automotive accessory manufacturer, Towson, Md. Murray Corp. is leasing Ranger from Chesapeake & Potomac Airways, Friendship Airport, to transport personnel and customers to and from plant and customers' offices.

Five-inch diameter indicator for RCA AVQ-50 lightweight business plane radar is interchangeable with current three-inch indicator, has gain control, range, tilt, contour and intensity controls grouped around the perimeter. RCA also displayed bright tube replacement for AVQ-50 which is interchange-



Weather Radio Sets

Two new short wave and standard broadcast band portables that will bring in weather reports are the new Weatherama top six-transistor set which uses four penlite cells and also receives on aeronautical beacon bands; larger T-9 Trans World fully transistorized receiver with six short wave and one standard broadcast bands. Price of the small set is $79.95, larger component lists for about $225. Philco is manufacturer

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Beech 1957 Sales

Total sales of more than $103 million were recorded by Beech Aircraft Corp. in fiscal year ended recently. Company has a current backlog of $107 million. Commercial aircraft sales of $35.5 million in Fiscal 1957 topped the previous year's $32,091,761. Military sales in the year just ended were approximately $68 million compared to $42,447,000 in Fiscal 1956.

Sales gain of better than 10% over last year is expected to be exceeded in current fiscal year due to company's new four place Travel Air light twin.

able with standard tube. It is said to be approximately 100 times brighter. New tube should go into production early next year. RCA has delivered some 50 AVQ-50 radars to dealers thus far for executive plane use.

First Cair Pagan Beech D18S conversion (AW Oct. 14, p. 14) has been delivered to Gertenslager Co., Wooster, O., truck body builder. New Pagan has useful load increased 900 lb. over standard models.

Integrally lighted instrument system, with bulbs placed behind dials, was displayed by Bendix-Pioneer Central. System is slated for DC-8 installation.

Bendix RDR-1D lightweight business plane radar will be priced at about $12,000 minus wave guide radome, is slated for go-ahead production some time the first of next year. Bendix will make a bright tube available as optional equipment later in 1958. It will be interchangeable with present tube.

Goodyear's new automatic ice detector system, type 260 Mk. 8, will be available to business flyers in about 60 days, price will be about $500. Equipment weighs 16 lb. Two three-inch probes, extending into slipstream, react to icing and pick up pressure differential between detector and reference probes. System can be fitted to flash a light or activate the automatic controller of an ice protection system.

United Air Lines is initiating pilot proficiency training courses for executive fliers, including radar instruction ($75), meteorology ($150), limited DC-6 and Convair 340 simulator and Link training. Courses are identical to those given UAL's pilots. UAL will provide training at any of its major terminals for groups, will take small enrollments at its Denver, Colo., base. For details write: United Air Lines Operating Base, Flight Operations Division, Stapleton Airfield, Denver.

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MATS utilizes Skydrol for proved protection from hydraulic fluid fire

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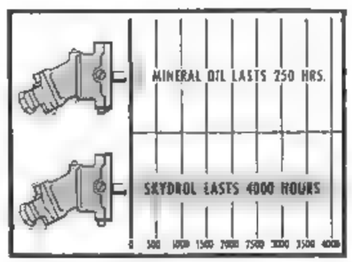

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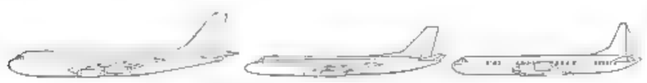

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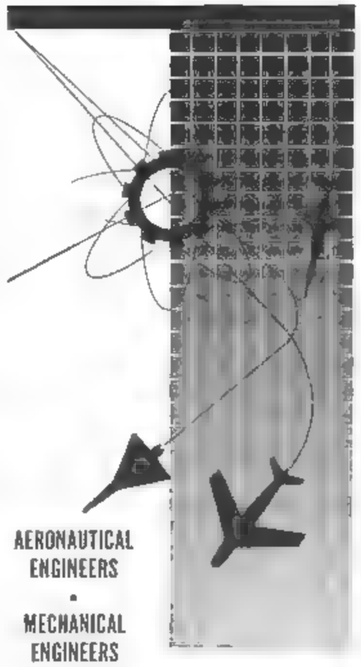

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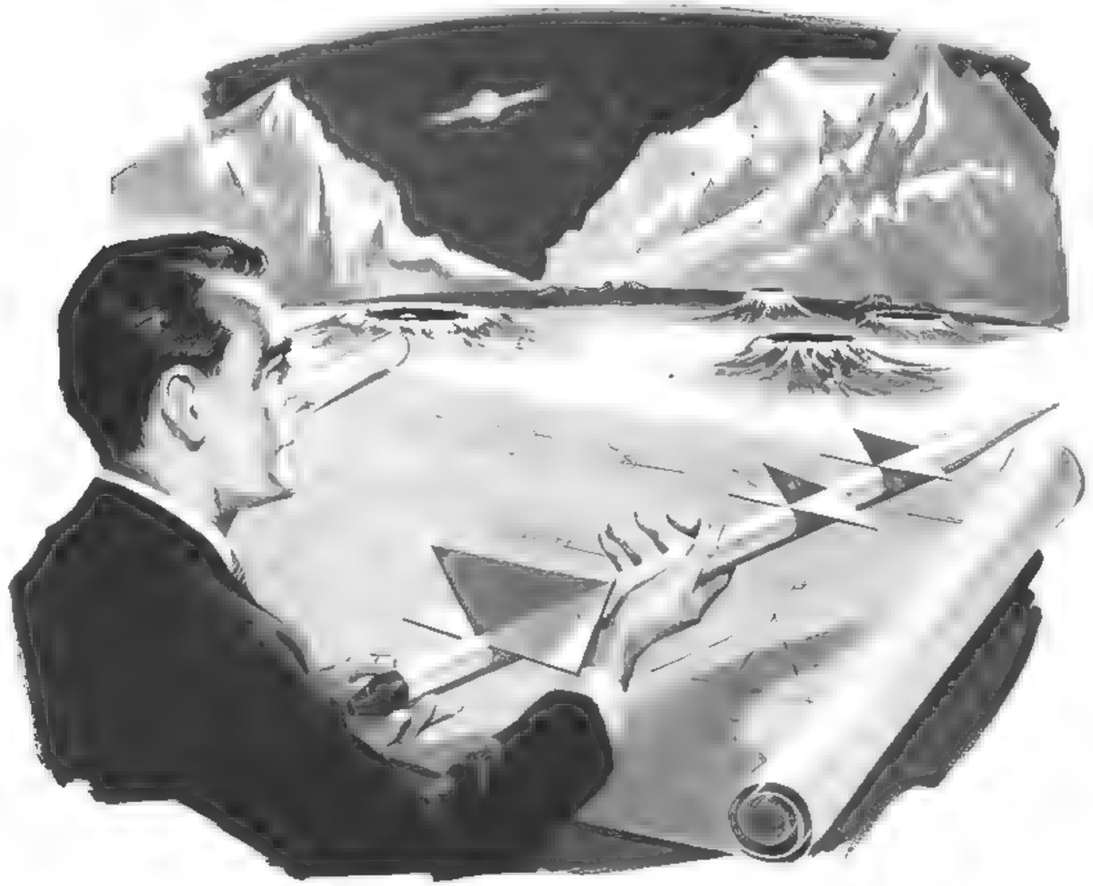

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LETTERS

F-105 Coverage

I have been away almost continuously since Aug. 1 and have not had the opportunity before this to thank you and your staff for the fine coverage of the F-105 in the July 29 and Aug. 5 editions of AVIATION WEEK. The material in both of the articles was not only authentic but also excellently presented.

KEN ELLINGTON
Vice President and
Asst. to the President
Republic Aviation Corp.
Farmingdale, N. Y.

Wants Fatigue Facts

I read the comments made by Mr. E. H. LaBombard of Douglas Aircraft in the article entitled "Ground Test Load Cycles Called Invalid as Fatigue Life Measure" published in the Sept. 23 issue of AVIATION WEEK (p. 64). I had to re-read it a number of times to determine what valid proof Mr. LaBombard had for making some of the statements. The article was much too short for the technical statements made and, therefore, the article proved to be one of opinion rather than fact. To begin with, the startling statement that "ground test load cycles are considered invalid as fatigue life measure" is like stating that wind tunnel testing is considered invalid for obtaining flight load data, that high speed track testing and other methods of simulating actual conditions are invalid. I must agree that fatigue simulation is the least accurate method of simulating actual conditions but definitely not invalid. Many good books have been written on material and structural fatigue life, such as "Fatigue of Metals and Structures" by Grover, Gordon and Jackson of Batelle Memorial Institute prepared for Department of the Navy, dated 1954.

Almost unanimously they agreed that the "proof of the validity" is to test under actual conditions, but as Mr. LaBombard admitted, this is not practical in many cases, but what's more important, it is not considered very scientific.

The big question is what would be the simplest, yet reasonably accurate method to duplicate "fatigue life" of a critical component area. Mr. LaBombard's suggestion does not appear to be very economical nor much more accurate than the methods now used by major industry. Douglas Aircraft abandoned as fruitless the effort to set up approximations of the number of cycles or the amount of time required to make a component fail due to fatigue, but this does not mean that other aircraft manufacturers met the same defeat. The main reason why accurate rapid simulation of fatigue life is so difficult is because of the many parameters that control component fatigue life, such as material properties, joint design, fastener properties, machined surface finishes and probably others.

The problem is not as simple as determining the fatigue life of a rotating bar under load.

Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address Letters to the Editor, Aviation Week, 330 W. 42 St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

I cannot propose any simple solution to the problem, but feel that ground test load cycle testing is valid as a measure of fatigue life if properly executed. To keep these remarks short, I will make no comment about the reliability of testing a small section of a fuselage versus testing the complete fuselage since the author contradicts his original statement of the value of duplicating actual conditions. In the fuselage test he assumes he knows which component has the least fatigue life.

In reference to the definition of the term "fatigue life," it was my impression that it was well known among engineers that the term applied not to the aircraft, but to the "weakest" component of the aircraft. If many components had the same number of fatigue life hours, it could apply to the aircraft since, as Mr. LaBombard stated, maintenance on component replacement costs could be unbearable. Personally, I would have no desire to fly any longer in a "properly designed" aircraft that approached its fatigue life by noticeable cracks in wing spar caps, fuselage longerons, etc. Of course, I am not referring to the DC-3, a Douglas product which may outlive me.

With all apologies to Mr. LaBombard, my only purpose for these comments is to indicate to AVIATION WEEK readers that there are other engineers who differ with his views.

LEON S. JABLECKI
(A.F.) I. A. S.
Tullahoma, Tenn.

Small Firms Produce

Your increasing interest in the small company engaged in research and development activities (AW July 8, p. 99), although somewhat belated, is heartening. I have reference to articles which describe small specialized technical companies, specialized personnel and their strong interest in progress, both personal and professional.

If we stop to recall, even for a fleeting instant, that every large company (built up on Defense Department projects) is comprised of individual small groups and individual people, the idea becomes increasingly palatable that the major contribution to scientific progress comes, ordinarily, from the mind of a single man. What difference, then, if the man works in a small select group or surrounded by thousands of fellow workers?

The difference is this—in a large company, large and even monstrous facilities are available—enough to gobble up the individual gifts and bury them forever in a maze of red-tape, political maneuvering and, last but not least, scheduling.

Is there in existence a single facility, laboratory or test equipment of appreciable size, complexity or cost that the individual technologist is free to use without schedules, conferences, approvals, test plans, analyses, reports and work orders? Of course, a small company cannot provide the individual scientist or engineer with cyclotrons, supersonic wind tunnels, multichannel computing machines, completely equipped electronic laboratories, etc., but neither does it provide him with the company supervisory hierarchy, the time clocks, the multitudinous rules and regulations, the long lines of approval signatures, the forms, the clerical echelons and the loss of individual entity and incentive.

Rather than emulate amazement that the small technical group can make important contributions and can survive in the economic jungle of defense procurement, it appears that AVIATION WEEK should express a degree of surprise that significant progress (per dollar expended) has been accomplished under some of the major weapon system contracts. Under a different organizational structure than now accepted by the aeronautical and related industries in this country, perhaps the urge for self expression, professional accomplishment and efficiency could be achieved in a large organization.

Thus the present corporate trend toward the acquisition of small outside groups successful in these respects, by merger, purchase or financial interest, would not be necessary.

Speaking for my company (The West Coast Research Corp.) which has been in operation for six years, we have weathered a number of economic storms and remained independent. Starting out as a group of consultants who devoted part time to solution of problems in aerodynamics, ballistics, instrumentation and measurement, we found that the uncertainties of repeat business, when a particular problem was solved, demanded some sustaining activity. This we sought in the design and fabrication of specialized instruments and equipment. It has apparently paid off on our level of operations, which we are not too ambitious to overexpand, with attendant loss of management control and loss of individual satisfaction.

After six years, we still find it expedient to maintain a sizable staff of consultants for particularly complex problems of any level of technical difficulty. The broad scope of our consulting staff permits us to operate effectively (as well as efficiently costwise) on a wider range of technical subjects than is found in the capabilities of companies many times our size. The basic reasons, we feel, are mentioned above. Our interests cover aerodynamics, ballistics, flight testing, wind tunnels, computer measurement and control equipment in which our specialists make continual contributions. Our clients are mainly the military and the defense contractors, although we look forward to developments with which we hope to enter commercial technical markets.

H. M. SPIVACK, PRESIDENT
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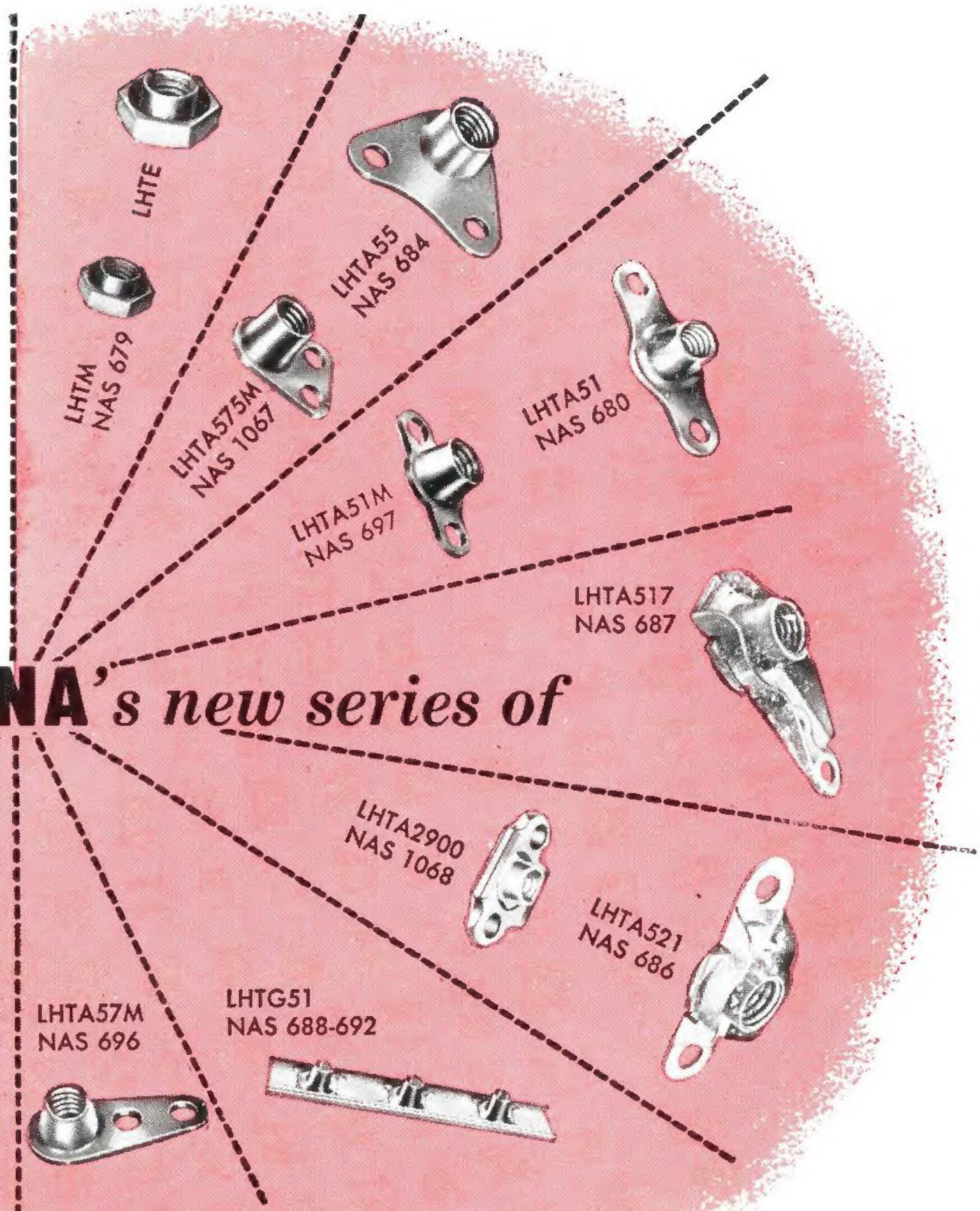

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